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The Relationship of Abdominal Strength to Selected Posture Faults

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IT HAS been assumed by some authorities that weakness of the abdominal muscles has been one of the important causes of certain postural faults, namely, downward tilting of the pelvis or hollow back (1, 2, 3, 4) and sway-back[1] or overcarriage (1, 4). Weakness of the abdominal muscles has also been thought to be one of the many causes of dysmenorrhea (5, 6, 7). As there seems to be little experimental evidence to support these theories, an investigation of these problems seemed to be in order. It is not a difficult job to develop strength in this muscle group and if muscular weakness contributes to these conditions of faulty posture and dysmenorrhea, it would be a simple matter to relieve the situations by strengthening the muscle group.

Statement of the Problem

It is the purpose of this study to determine the relationship of abdominal muscle strength to certain posture faults, namely, sway-back and pelvic tilt downward and to the incidence of dysmenorrhea among women of college age.

Procedure

Antero-posterior posture pictures of women enrolled at the State University of Iowa in the Basic Skills Program were studied and subjects judged to have a faulty pelvic tilt or to be sway-backed were chosen from this total group. The subjects were selected by two graduate students in physical education with the help of an instructor experienced in the field of posture and body mechanics. The judges worked together in selecting subjects. The criteria used to evaluate sway-back were the position of the gravital line relative to the distribution of the body parts and the relationship of a line tangent to the thoracic curve to that of a line tangent to the buttocks. Subjects were selected for faulty pelvic tilt on the basis of the relative position of the anterior superior spine of the ilium. The control group was selected by testing several classes taken at random from those offered in the spring of 1950. They included volleyball and tennis classes

[1] Sway-back is used in this paper to refer to that body posture where the individual leans backward from the waist carrying the center of gravity backward and thus increasing the normal lumbar concavity.

and freshman major students. To insure the fact that the major students did not cause a skewing of the distribution, the mean and standard deviation of that group were computed separately and compared with the same measures on the non-major group. When it was ascertained that the mean score for abdominal strength for majors was actually lower than that for non-majors, it was judged safe to include them as part of the control group.

Abdominal strength was tested[2] using equipment designed for this purpose.[3] A hand dynamometer enclosed in the push-pull apparatus was bolted to a board which in turn was wired to a plinth. Running from the dynamometer were two chains which were snapped to a two-inch leather belt. The plinth was narrow in the center so the chains had an almost perpendicular line of pull between the subject and the dynamometer.

The subject was instructed to lie down on the plinth on her back with her knees bent and feet on the plinth. Her position was adjusted so that the belt was at approximately the level of the ninth or tenth rib. A thin layer of felt was laid across the thorax to avoid pinching when the trunk was lifted against the belt. The belt was tightened so that it fit snugly but did not inhibit movement too much.

The subject was instructed to place her arms at her sides without touching anything and to curl up as hard as she could. Her feet were held down during the attempted curl and she was cautioned not to jerk but to pull steadily. The belt and chains were so adjusted that she was able to sit up only part way. Three trials were given and the score recorded in pounds. The median score was used for computational purposes.

Reliability scores were established by retesting after an interval of several days and correlating the two scores using the Pearson Product-Moment Method of correlation.

The significance of the differences of the mean abdominal strength between the control group and the two experimental groups was compared by using the critical ratio.

The menstrual history was obtained from data taken at the entrance interview. Dysmenorrhea is recorded at that time as none, slight, moderate, or severe with the student judging the severity. The procedure of using student evaluation of severity of dysmenorrhea is, of course, open to some question. However, as intensity of pain is difficult to determine objectively there seemed to be no way of solving this problem. Amount of time lost from classes as a result of dysmenorrhea was used as a means of making the judgment more uniform. If no time was lost but there was discomfort the rating was given as slight. Dysmenorrhea was rated as moderate if, as a usual thing, class time up to a half day was lost. When more than half a day was lost regularly, dysmenorrhea was rated as severe. Other menstrual irregularities are recorded also but were disregarded for this study because of limited number of cases. Using the distribution of none, slight, moderate,

[2] The author wishes to acknowledge the assistance given by Dorris Steffy and Madeline Kao.

[3] Scott, M. Gladys. *Abdominal Strength*. Unpublished study.

or severe pain found in the control group as what might be expected as standard, the incidence of dysmenorrhea found in the faulty pelvic tilt and sway-back groups was compared using X^2.

Analysis of Data

The reliability of the sit-up test of abdominal strength when given at two separate times was found to be $r = .78$. While this is not as high as might be expected of a test involving such a simple procedure, it may be accounted for, in part, by differences in motivation and effort.

Apparently there is little relationship between faulty pelvic position and abdominal strength as the critical ratio is of no significance. (Table 1.) However, the judges found it very difficult to detect faulty pelvic tilt from the photographs using the criterion agreed upon. This may be a partial

TABLE 1
Abdominal strength

GROUP	NUMBER	MEAN	STANDARD DEVIATION	CRITICAL RATIO CONTROL AND DEVIATION GROUPS
Control	50	86.36	23.26	
Sway-back	27	78.00	23.66	1.55
Faulty pelvic tilt	41	83.98	29.45	0.42

TABLE 2
Incidence of dysmenorrhea in experimental groups

GROUP	X^2	LEVEL OF CONFIDENCE
Sway-back	30.89	.01
Faulty pelvic tilt	4.09	.30

explanation for the lack of relationship. Sway-back also appears to be related to lack of abdominal strength only by chance as seen in Table 1.

The *chi square* distribution comparing the incidence of dysmenorrhea in the faulty pelvic tilt group with the distribution found in the control group was of no significance. In the sway-back group however, the increase in dysmenorrhea is in no way to be attributed to chance variation as the X^2 is significant at less than the 1% level of confidence. (Table 2.)

Summary and Conclusions

In comparing abdominal strength of a control group with two groups possessing posture faults, namely pelvic tilt downward and sway-back, it may be concluded from these data that:

1. Faulty pelvic tilt, apparently, is not associated with any significant weakness in abdominal musculature, at least in this group.
2. Sway-back probably is not associated with weakness of the abdominal muscles.

3. The incidence of dysmenorrhea in varying degrees seems to be no different for those having a faulty pelvic position than those selected as controls.
4. Dysmenorrhea occurs with greater severity among the sway-back group than among the control group.

It is suggested that further study be done on this problem from the standpoint of testing the abdominal strength of a greater number of sway-backed individuals. It is also suggested that the study be repeated on those having a faulty pelvic tilt but that in selecting the cases, the subjects be chosen by examining them individually instead of selecting cases from photographs.

Implications

While lack of abdominal strength in relation to sway-back is not significant enough to be interpreted as a positive causal factor, the results would indicate that in trying to correct sway-back in individuals, one should not overlook this as a possible cause for this posture deviation.

The causes of dysmenorrhea are numerous. However, with such a significant X^2 it would seem to indicate that one should bear in mind that lack of abdominal strength may be a causative factor in this condition.

SELECTED REFERENCES

1. Drew, L. C. and Kinzly, H. *Individual Gymnastics*. Philadelphia: Lea and Febiger, 1945. p. 49–50.
2. Hawley, Gertrude. *The Kinesiology of Corrective Exercise*. Philadelphia: Lea and Febiger, 1949. p. 11.
3. Phelps, W. M. and Kiphuth, R. J. H. *The Diagnosis and Treatment of Postural Defects*. Baltimore: Charles C. Thomas, 1932. p. 67, 102, 103, 124.
4. Scott, M. Gladys. *Analysis of Human Motion*. New York: F. S. Crofts and Co., 1942. p. 334–35.
5. Duggan, Anne Schley; Montague, Mary Ella; and Abbie Rutledge. *Conditioning Exercises for Girls and Women*. New York: A. S. Barnes and Co., 1945. p. 43.
6. Miller, Norman. "Posture Studies in Gynecology," *Journal of the American Medical Association* **89:** 1761, 1927.
7. Drew, L. C. *op. cit.*, p. 121.

The Effect of Weight Lifting Upon the Speed of Muscular Contractions

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Many coaches, trainers, and others associated with physical education are of the opinion that training with heavy weights will lead to slower muscle contractions and hence will slow down the athlete; consequently, they prohibit weight lifting by men under their supervision whose success depends upon speed.

On the other hand, some coaches and trainers claim that weight lifting is very helpful in training theii athletes. Unfortunately neither group has produced any documented evidence for their contentions.

As far as we know, there has been no research conducted specifically related to this controversial problem. The need, however, is felt and expressed by those associated with physical education. For this reason the present investigation has been undertaken.

Since weight lifting affects especially the muscles of the arms and of the upper girdle, it was decided to study the effect of weight lifting on these particular muscle groups.

Subjects

Six hundred men, whose ages ranged from 18 to 30 years, were used. They were divided into two groups of 300 men each.

One group consisted of men who never indulged in weight lifting and was used as a control group. In this group were 150 men from Springfield College and 150 from a liberal arts college.

The other group was composed of weight lifters who had participated in weight lifting for a minimum of six months and were still engaged in this activity. Some men were tested at the 1950 Senior National AAU Weight Lifting Championships and Mr. America contest held in Philadelphia. These men were from various parts of the world, Australia, Hawaii, Puerto Rico, Canada, and many states of this country. The many weight lifting and body building clubs located in New York City and Western Massachusetts also contributed subjects used in this study. They varied from little known weight lifters to world champions and from unknown body builders to winners of the Mr. America physique contest.

Preliminary Testing

Several types of arm motion have been tried during exploratory experimentation and several special devices were constructed for this purpose

before the apparatus finally used in this study was developed. One trial machine required an up and down arm motion in a vertical plane. Contact switches for recording complete movements were placed at the top and bottom of the machine. It was found however, that when the subject moved his arm rapidly there was a tendency not to complete the full movement and contact with the switches was not made each time. Another trial machine

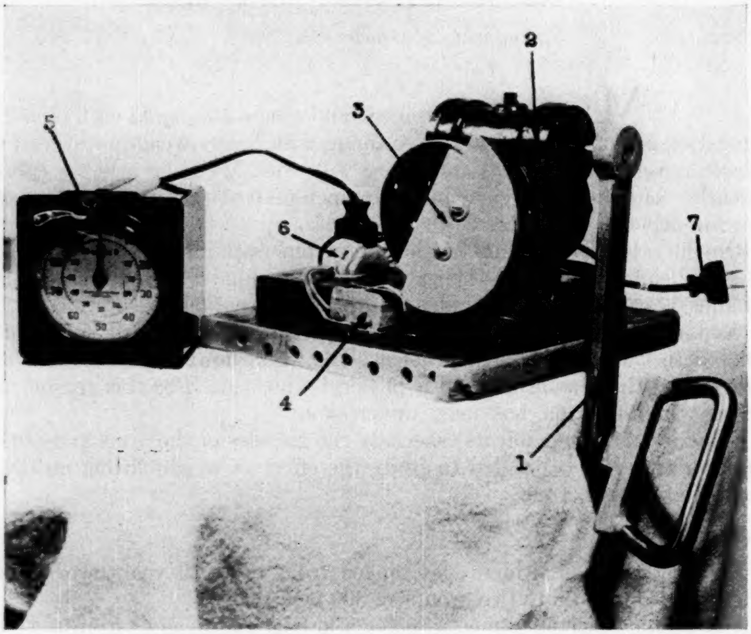

FIG. I. Apparatus for Automatic Recording of Rotary Movements of the Arm. The turning of the arm and handle (1) which is attached to the gear reduction box (2) causes the cam (3) to rotate at a one to twenty-four ratio. This cam depresses the micro-switch (4) thus completing the circuit which starts the electric clock (5). When the arm and handle has been turned 24 complete times, the cam will have completed its required distance and will release the micro-switch, thus breaking the electric circuit and stopping the clock. An electric plug connection (6) and an electric plug (7) were used to connect with the conventional electric outlet for 110 volt A.C.

involved a rotary arm motion in a sagittal plane and was found to be impractical because at certain times the extended arm would lock at the elbow, thus interfering with completion of the movement.

After all these preliminary tests, it was found that a clockwise rotation of the arm in which the hand described a circle in a frontal plane was the most satisfactory. The clockwise rotation was chosen because this movement is more natural than in the counterclockwise one and the pronator muscles are stronger than the supinator muscles.

It was important to minimize the fatigue and learning factors. A test consisting of two trials of 24 complete revolutions each was found to be most satisfactory.

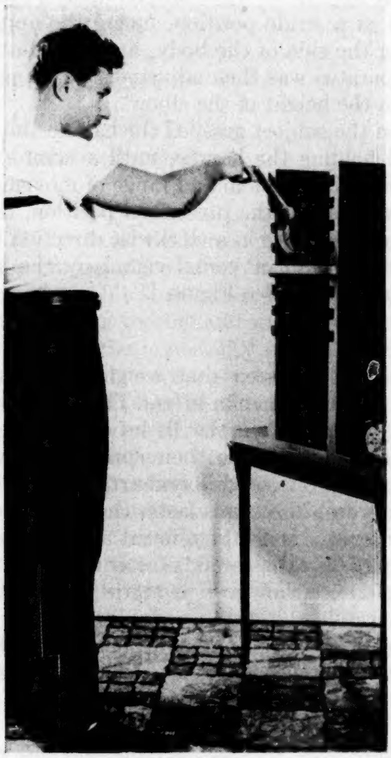

FIG. II. Apparatus for Testing Speed of Arm Movement in Action.

TABLE 1

Statistical data obtained on the lifters and non-lifters

GROUP	MEAN TIME IN SECONDS	EXCESS TIME OVER GROUP I	σ	σ_m
1. Weight Lifters	5.491	—	.344	.0198
2. Non-Weight Lifters	5.665	.174	.392	.0226
3. Springfield College	5.55	.06	.373	.03
4. Liberal Arts College	5.78	.29	.377	.03

Method

A specially constructed apparatus recording speed of rotary movements of the arm was used. It automatically registered to a hundredth of a second

the time of 24 complete rotary movements of the arm. (See Figure I.) Each subject had two trials with a three minute rest between tests. The lower time of the two recordings was used as representative of the subject's speed.

The cabinet of the apparatus was clamped upon a table and the subject stood with the feet in a stride position, facing the apparatus. The elbow was placed touching the side of the body, arm flexed at right angle, palm downward. The apparatus was then adjusted by having the handle of the apparatus level with the height of the elbow.

From this position the subject grasped the handle and moved away from the apparatus, still holding the handle, until a comfortable position was attained. The arm had full freedom and range of movement.

When the subject attained the prescribed position, he proceeded at his own discretion to move his arm in a clockwise direction turning the handle as fast as possible until given a verbal signal by the tester that the 24 movements were completed. (See Figure II.)

Analysis of Data

From Table 1 it may be seen that weight lifters were faster in the speed of rotary arm motion than non-lifters. The difference was .174 seconds, which is statistically significant at the .01 level of confidence.

All subjects ranked according to their speed as follows: weight lifters, Springfield College non-lifters, and liberal arts non-lifters.

The weight lifters were .29 seconds faster than the students of the liberal arts college. This difference is also significant at the .01 level of confidence.

The lifter group was only .06 seconds faster than the Springfield College non-lifters. This difference, however, is statistically significant at the .05 level of confidence.

In the non-lifter group the Springfield College students were .23 seconds faster than students from the liberal arts college. This difference is statistically significant at the .01 level of confidence.

Summary and Conclusions

The findings of this study appear to be contrary to the common opinion of coaches, trainers, and others associated with physical education who believe that weight lifting will slow down the athlete.

On the basis of the obtained data it is evident that:

1. The weight-lifting group was faster in their rotary motions of the arm than the non-lifters.
2. The non-lifters from Springfield College were faster than the non-lifters from the liberal arts college. This is probably because they engage in physical activities more than the students of the liberal arts college.

A Study of the Learning of Fundamental Skills by College Freshman Women of Low Motor Ability

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TEACHERS in all fields recognize differences in ability and in aptitude for learning among the students in their classes. The presence in a class of those students who lack basic knowledge or who are slow in learning leads to problems for teacher and students alike. Without considerable individual instruction the low ability students cannot attain a satisfactory degree of success in the average class.

This same problem exists in physical education classes. Students who have poor coordination, those who have little skill, and the slow learners tax the skill and ingenuity of the teacher whose class is heterogeneous in ability. Objective tests can be used to select some of those whose basic knowledge and general motor ability are below average and who are likely to be handicapped in learning motor skills. It is this group which all too frequently receives little attention in the teaching situation, whereas they actually require more specialized teaching. The dearth of literature directly concerned with the low motor ability group is, in all probability, a reflection of the lack of emphasis placed on this phase of physical education teaching. This group can in some situations, particularly at the college level, be given special instruction in those general skills which they have not developed. By providing special classes this instruction can be planned to meet the needs of the group and presented at the rate most conducive to learning. The problem is not solved simply by segregating the group and teaching the same material by the same procedures used in other classes, however. Careful selection of materials and special methods and techniques of presentation are essential to the success of the program. A friendly class atmosphere is extremely important with this group.

At the State University of Iowa the physical education requirement is a proficiency requirement rather than a time requirement. Women students must demonstrate satisfactory skill and knowledge in five areas: safety, body mechanics, efficiency, group activity and individual activity. In any situation such as this, in which all individuals are required to meet minimum standards, it becomes imperative that students of inferior ability be given special assistance.

A standardized test of motor ability is used at Iowa to classify entering

freshman women. Those students whose T-scores on the motor ability test are in the lower one-fourth are advised to register for skills clinic, a class in the fundamental motor skills: running, jumping, throwing, striking. Through analysis, demonstration, and practice the student develops skills which are basic to other and more specific sports skills. Then she is introduced to a variety of sports in which these skills are used.

Purpose

The purposes of this study are:

1. To determine the status of college freshman women of low motor ability in these motor characteristics:
   a. agility
   b. balance
   c. kinesthetic response
   d. serial reaction time
   e. strength
2. To compare the effectiveness of 8 weeks and 16 weeks of instruction in the fundamental skills.

Procedure

The Scott motor ability test was administered to all physically able freshman women entering the State University of Iowa in September 1949 and motor ability T-scores were computed(1). On the basis of the T-scores, two groups were selected: those whose scores were in the lower one-fourth and who were subsequently advised to register for skills clinic—hereinafter referred to as the low motor group; and those whose scores were in the upper one-fourth—the high motor group. The low motor group included 89 subjects, the high group 84.

Students in these two groups were given tests in the motor characteristics selected for study. The obstacle race from the Scott motor ability battery was used as a measure of agility (2). The balance test is a test of dynamic balance requiring movement in two planes at right angles (3). Kinesthesis was measured by a battery of tests all of which required reproduction of a position of arm or leg without the use of visual cues (4). The serial reaction time test was scored by recording the time required to perform a series of short runs involving change of direction as indicated by verbal signals (5). Assuming arm and shoulder girdle strength to be a valid indication of general strength, a dynamometer with a push-pull attachment was used to measure strength (6). Low and high groups were compared on the basis of scores on these tests. Range, mean, standard deviation, and critical ratio were calculated.

The low motor group was registered in four sections of skills clinic, the sectioning determined by total university schedules of the students. On the bases of general motor ability T-scores, number of students per class, and class hours, two low motor groups were formed by combining two sections for each group, with the object of forming two equivalent groups. One group, 44 students, was scheduled for skills clinic for one term of 8 weeks,

as has been previous practice. The other 45 students were scheduled, on an experimental basis, for one semester of 16 weeks in skills clinic. Critical ratios were used to determine the degree to which these two groups were equated on all the initial tests.

All sections of skills clinic were taught by the author. At the end of the first term, the 8-week class repeated all the skill tests. Initial and final test scores were compared by critical ratios to ascertain the change in status following 8 weeks enrolment in skills clinic. Improvement scores (difference between initial and final test scores) were calculated for each individual and the means of the distributions were computed. The 8-week group wrote the skills clinic examination prepared by the physical education department and previously used in skills clinic classes.

Students from the 8-week group registered for activity classes of their choice and were then enrolled in regular classes with other college students. The 16-week group continued as in the first term with further instruction in the fundamental skills and concentration on volleyball with the aim of meeting the group activity requirement of the skills program through that sport. Volleyball was chosen because it has been shown to be one of the easiest activities for low motor ability students to master and because it was suited to the size of the classes and the facilities available.

At the end of the semester the 16-week class repeated the skill tests and the data were handled as for the 8-week group. In addition, these students took information and performance tests in volleyball. They wrote the same skills clinic examination which the 8-week group had written at the end of the first term.

Final test scores and improvement scores for 8- and 16-week groups were compared. Critical ratios were used as a partial means of determining the relative effectiveness of the two procedures.

Records of former students who had completed all requirements in physical education skills were studied. These students formed two groups: those who had been enrolled in skills clinic and those who had not.

The progress of the 8-and 16-week groups was studied at the end of the third term—the middle of the second semester. The criteria of progress were the tests passed by each student. For each group, computation was made of the number and percent who had passed information, performance, or both tests in each of the five areas.

Analysis of Data

A comparison was made of the performance of the upper and lower quartile groups on the initial tests. Since the groups were formed on the basis of motor ability scores it is to be expected that they would differ significantly in general motor ability. Little attempt has been made to discover how groups so differentiated by a motor ability test compare in other motor characteristics, such as agility, balance, strength, and others. This is one of the purposes of this study. Results indicate that the two groups are indeed different in certain motor characteristics.

Upper and lower groups differed significantly in agility, push and pull strength, balance and serial reaction time—critical ratios in all cases being statistically significant at better than the 1% level of confidence.

Results obtained from the tests of kinesthesis were somewhat contradictory throughout. As Table 1 shows, on the initial tests the mean scores of the lower group were in some instances superior to scores of the upper group. Final scores of the two groups of skills clinic students indicated improvement in some of the tests and not in others. It is probable that the tests should be refined or other tests of kinesthesia be devised.

Data collected in this study indicate that the group which is segregated by use of a general motor ability test differs, not only in general ability, but also in a variety of motor capacities. Some of these differences may be clues to low performance on the general motor ability test; certainly all should be studied carefully in planning the content of a unit of instruction in the fundamental skills.

TABLE 1

Mean scores of groups on tests of kinesthetic response

GROUP	TEST			
	Target point	*Deviation—arm	*Deviation—leg	Total T-score
Upper	30.57	7.41	13.26	149
Eight-week				
Initial	28.35	7.92	14.04	145.55
Final	30.36	7.56	10.92	149.85
Sixteen-week				
Initial	32.73	6.82	12.54	152.65
Final	35.46	10.28	13.77	148.60

The second purpose of the study is to compare the effectiveness of 8- and 16-week units in skills clinic. In order to make any comparison of results one must know initial status. Initial test scores for 8- and 16-week groups were compared. None of the differences was significant at even the 2% level. The majority was much smaller, totally lacking in statistical significance. Thus the two groups may be considered approximately equivalent before instruction began.

Initial and final test scores for the 8-week group were compared as the basis for measuring changes resulting from 8 weeks of instruction in skills clinic. The mean motor ability T-score for the group on the initial test was 39.64, on the final test 50.35, evidence that general motor ability is amenable to change through instruction and practice over even a brief period of time.

Improvement in all the skill tests followed 8 weeks in skills clinic. Critical ratios significant above the 1% level were obtained for differences between initial and final test scores in agility, balance, and serial reaction time. The difference for push strength was significant at above the 5% level.

These data show that it is possible during an 8-week skills clinic unit to increase the mean motor ability score of a group of students and at the same time to improve some motor characteristics. Most important, these results were shown on the group of students usually considered "dubs."

Data for the 16-week group were treated as for the 8-week group. Again it was obvious that general motor ability can be improved, the mean T-score having changed from 39.70 to 54.50, thus approaching the third quartile point.

It is interesting that those skills showing most change are identical for the two groups. Tests in which the 16-week group made significant changes in mean scores were agility, balance, and serial reaction time, with critical

TABLE 2

Comparison of 8-week and 16-week groups' final test scores

TEST	EIGHT-WEEK GROUP (N—43)			SIXTEEN-WEEK GROUP (N—43)			C.R.
	Range	Mean	S.D.	Range	Mean	S.D.	
GMA T-Score	38–58	50.35	5.28	38–67	54.40	6.62	3.12
Agility (seconds)	19.3–25.8	22.10	1.48	19.4–27.3	22.06	1.54	.12
Basketball throw (feet)	24–44	35.19	4.55	30–56	38.54	5.54	3.07
Broad jump (inches)	46–72	61.30	6.12	40–77	64.64	7.76	2.20
Wall pass	5–12	9.14	1.57	6–12	8.95	1.19	.20[a]
Strength (dynamometer #)							
Pull	36–70	48.74	7.96	34–67	46.90	7.24	1.12[a]
Push	24–58	42.08	8.78	24–58	42.40	7.80	.18
Balance	4–10	7.74	1.83	1–10	8.09	1.96	.85
Serial reaction (seconds)	33.0–43.3	37.46	2.61	33.0–46.7	38.73	2.57	2.27[a]
Kinesthesis							
Target point	2–48	30.36	10.71	15–48	35.46	9.28	2.35
°Arm deviation	0–22	7.56	4.90	0–31	10.28	7.40	2.00[a]
°Leg deviation	2–24	10.92	5.34	2–55	13.77	9.12	1.77[a]
Total T-score	119–177	149.85	13.98	90–173	148.60	14.80	.40[a]
Written examination	13–27	20.63	3.33	16–31	22.91	3.42	3.12

[a] Favors 8-week group

ratios significant at better than the 1% level. The critical ratio of the difference on the test of push strength was significant at the 2% level.

Eight- and 16-week groups were compared on the basis of final test scores. Table 2 gives final test scores. In analyzing these data one must bear in mind that the two groups were not strictly equated on initial tests, though none of the differences was significant at the 1% level. It was in the motor ability test and the written test that the 16-week group furthest excelled the 8-week group. Differences between final test scores on these two tests were significant at better than the 1% level.

Results of the strength tests were somewhat incongruous. The differences between final test scores on the pull, though significant at only the 13% level of confidence, favored the 8-week group. The mean final score for the 8-week group was 48.74 pounds, for the 16-week group 46.90 pounds. Final

test scores on the push test differed only minutely. The activity schedule for the two groups probably holds the explanation. Though formal exercise continues over a longer time interval in the 16-week class, these results may confirm the belief that strength is built through concentrated effort, rather than through exercise spread over a longer period. The sport activities may be related also. Softball was the predominant sport in the 8-week group while the 16-week group, particularly during the 8 weeks before the final tests, concentrated on volleyball. Softball doubtless makes greater demands on arm and shoulder girdle muscles than does volleyball.

The difference between final test scores in the serial reaction time test, significant at between the 2% level and the 5% level, also favored the 8-week class. Again study of class activity may aid in interpretation. Running, reversing, dodging were stressed in the first 8 weeks. During this practice students were placed in situations in which they were reacting to starting, stopping, and change of direction signals. Softball batting, fielding, and baserunning are activities in which emphasis is placed upon reacting quickly to instantaneous stimuli. The 16-week group had had this experience, but the time lapse between activity and test may have been so long as to result in loss of much of the ability gained.

Comparison of the 8- and 16-week groups on the basis of improvement scores is perhaps a more accurate means of appraising the relative gains of the two groups. These data are shown in Table 3. Results parallel closely the final test scores, reflecting the similarity of the groups on initial tests. The motor ability test appears to measure those skills which benefit most from a longer learning period. This is to be expected since the principal objective of skills clinic is development of the fundamental skills. The broad jump and the basketball throw were the two items from the motor ability test most responsible for the significant difference between the two groups.

The only other statistically significant differences favored the 8-week group. Most highly significant were improvement in serial reaction time and the pull test. Possible explanations have been advanced in the preceding discussion of final test scores.

Subjects in the 16-week group showed decreased accuracy in the arm and leg raising tests of kinesthesis. The 8-week group improved. Differences between the mean improvement scores were significant at the 5 and 6% levels. The difference between improvement in total T-score in kinesthesis reflects these results.

Statistics shown in Table 3 indicate that low motor ability students can make greater improvement in general motor ability in a semester than is possible in 8 weeks. However, these students gain from the longer unit nothing in the motor characteristics here measured. The final answer to the value of the longer term must come from study of the records of these students in activity classes following skills-clinic instruction. An effort must be made to determine whether they are better equipped to learn sport skills after a semester in skills clinic.

Records of 103 former low motor ability students who had already com-

pleted physical education requirements were studied in an attempt to further evaluate the role of skills clinic. In the past several students from the low group have not been enrolled in skills clinic, chiefly because of scheduling difficulties. The low motor ability students who had been enrolled in skills clinic required slightly longer to complete their requirements than did the other low motor ability students (2.93 semesters as compared to 2.61 semesters), the difference being significant at the 8% level of confidence. However, for those who had skills clinic, one term of this registration was spent in a class which is not directly applicable to the skills requirement. Thus the number of terms required for completion of requirements was actually less. This means that the students were, after instruc-

TABLE 3

Comparison of eight-week and sixteen-week groups' improvement scores

TEST	EIGHT-WEEK GROUP (N—43)			SIXTEEN-WEEK GROUP (N—43)			C.R.
	Range	Mean	S.D.	Range	Mean	S.D.	
GMA T-score	−2–21	10.78	4.72	1–28	14.50	5.54	3.32
Agility (seconds)	1.3–8.3	4.14	1.88	1.5–11.3	4.70	2.16	1.27
Basketball throw (feet)	−3–16	7.51	4.26	−2–23	9.72	5.34	2.12
Broad jump (inches)	−6–20	5.98	5.28	−6–25	10.08	6.56	3.18
Wall pass	−3–3	−.12	1.37	−4–2	−.34	1.28	.76[a]
Strength (dynamometer #)							
Pull	−8–20	3.66	5.24	−9–10	.89	5.00	2.50[a]
Push	−12–22	4.50	7.44	−14–19	4.90	7.28	.25
Balance	−2–6	1.72	2.23	−3–7	1.77	2.26	.10
Serial reaction (seconds)	.9–12.2	5.32	2.53	−4.8–10.1	3.20	2.49	3.93[a]
Kinesthesis							
Target point	−33–34	2.00	14.75	−24–35	3.42	9.90	.52
°Arm deviation	−15–32	.84	7.92	−28–27	−3.42	9.45	2.25[a]
°Leg deviation	−15–36	2.58	9.96	−47–20	−1.20	11.20	1.64[a]
Total T-score	−40–63	1.47	23.59	−59–42	−3.64	19.95	1.08[a]

[a] Favors 8-week group

tion in the fundamental skills, more successful in meeting performance and information standards in activity classes.

After the testing period at the end of the third term, records of students from the 8- and 16-week groups were studied to determine their progress on the skills requirements. Tabulation was made of information and performance tests attempted by those students who had been enrolled in physical education for three terms. From these data computation was made of the percent who passed each test and the percent who tried the test but failed. The 8-week group included 26 cases; the 16-week group 41. Three terms of enrolment represent two choices of activity for the 8-week group and one choice for the 16-week group.

The two groups differed little in their status in the safety area. Very few from either group were able to pass the safety performance (swimming) test without instruction at the university. In body mechanics the 8-week

group has made much more progress than the 16-week group, probably because the body mechanics class has been an available choice in two terms.

In the efficiency and group activity areas the 16-week group was more advanced. Both of these are areas on which effort had been concentrated during the 16-week skills clinic. The efficiency area is one which has always presented a major problem to the low motor ability students.

Least progress by both groups has been made in the individual activity area. Few have attempted these tests.

The total number of areas completed by each group was computed also. These data are presented in Table 4 in terms of the percent who had completed zero to five areas. Of the 16-week group, 47% had completed three or more areas while only 16% of the 8-week group had completed three or more.

These data indicate that the 16-week group has made more progress toward completion of the requirements than has the 8-week group. This may be evidence that the 16-week skills clinic is more effective than is the 8-week unit. It may, however, simply illustrate the importance for all students of a maximum of encouragement and guidance in planning their progress through the basic skills program.

TABLE 4

Areas of the physical education skills program completed in three terms

GROUP	NUMBER OF AREAS COMPLETED					
	0	1	2	3	4	5
Eight-week group	0	35%	50%	12%	4%	0
Sixteen-week group	12%	22%	20%	27%	15%	5%

Further study of these students as they complete skills requirements will give additional information on the effectiveness of the two skills clinic units.

Conclusions

Data presented in this study seem to justify the following conclusions.

1. Students who score in the lower quartile group on the Scott motor ability battery make scores significantly lower than those in the upper quartile group on these tests:
   a. agility
   b. balance
   c. serial reaction time
   d. push strength
   e. pull strength
2. General motor ability and certain motor capacities can be improved by specialized instruction in the fundamental skills.
3. General motor ability and knowledge of fundamental skills can be improved more during a 16-week unit than during an 8-week unit.
4. Sixteen weeks of instruction in the fundamental skills did not result in im-

provement in the motor capacities here measured greater than that which followed 8 weeks of instruction.

5. The 16-week group had at the end of three terms of physical education made more progress toward completion of the physical education basic skills requirement than had the 8-week group.

6. Some advantages of a longer unit in skills clinic were shown, but the evidence is not at present conclusive enough to warrant recommendation of adoption of the 16-week unit in the regular program.

REFERENCE LIST OF TESTS

1. General motor ability: Scott, M. Gladys and French, Esther. *Better Teaching through Testing.* New York: A. S. Barnes, 1945. Chapter 6.
2. Agility: *Ibid.* (Obstacle race from general motor ability battery.)
3. Balance: State University of Iowa, Department of Physical Education for Women. Unpublished departmental studies. Iowa City, Iowa.
4. Kinesthetic response: Young, Olive. "A Study of Kinesthesis in Relation to Selected Movements." *Research Quarterly* **16**: 277; December 1945.
   National Association of Physical Education for College Women. *Victory through Fitness.* Workshop, University of Wisconsin, Madison, Wisconsin, June 24–30, 1943. p. 47.
5. Serial reaction time: Salit, Elizabeth Powell. *The Development of Fundamental Sports Skills in Freshman College Women of Low Motor Ability.* Doctor's dissertation. Iowa City, Iowa: State University of Iowa, 1944.
6. Strength: Scott, M. Gladys and French, Esther. *op. cit.*, Chapter 5.

Preparing Beginning Teachers To Coach Physical Activities

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In this study it was proposed to formulate a program for the professional preparation of beginning teachers as sponsors of pupil activities in public secondary schools.[1] As a basis for the program, an attempt was made to ascertain the activities assigned to beginning teachers in New Jersey, to determine the training and experience these teachers had for their activity assignments, and to discover what opportunities colleges provided for the preparation of sponsors. This article summarizes only those findings related to coaches of physical activities.

For purposes of this investigation, a beginning teacher was defined as a teacher who did not have more than two years of teaching experience by the end of the school year, 1948–49. Some information about beginning teachers was obtained from 232 of the 250 principals of public secondary schools in New Jersey during the spring of 1949. Three hundred twenty-three beginning teachers provided further data in interviews and on questionnaires. These teachers were representative of the population of reported beginning teachers with respect to different types of schools and different kinds of activities. Both principals and teachers responded from schools employing various numbers of beginning teachers.

In order to supplement the information secured about the beginning teachers studied, a survey was made of the program which certain colleges and universities provided for the professional preparation of activity sponsors. Twenty-five institutions were selected for study because each awarded five or more degrees to graduates who were employed as beginning teachers. Representatives of eight colleges consented to interviews. Officials of 14 other institutions replied to questionnaires. The 22 colleges and universities from which information was obtained prepared two-thirds of the beginning teachers reported by principals. All 22 colleges are located in New Jersey, New York, and Pennsylvania. Eight of these institutions are state teachers colleges, six are universities, and eight are other colleges.

[1] William S. Sterner, *Preparation of Sponsors of Pupil Activities in Secondary Schools: A Program Based on Experience of Beginning Teachers in New Jersey Public High Schools.* Doctor's dissertation. New Brunswick: Rutgers University, The State University of New Jersey, 1950. p. 242. (Unpublished)

Sponsor Groups

More than 96% of the beginning teachers sponsored pupil activities of different types and in various combinations. Thirteen years earlier Smith[2] discovered practically all inexperienced academic teachers in New Jersey high schools were assigned at least one extracurricular activity. In both investigations about the same percentage of inexperienced or beginning teachers coached football, basketball, and baseball. In order to analyze the preparation of sponsors in the present study, beginning teachers were grouped according to their major responsibilities for activities. Subsequent paragraphs describe the four groups of sponsors of physical activities.[3]

The first group, coaches of football and boys' basketball, included 46 men. Half of the 40 football coaches also were in charge of boys' basketball. Only six basketball coaches did not serve as tutors of football. In general each man was responsible for more than two physical activities. About one-half of these coaches sponsored homeroom, civic, social, or club activities. Seldom did they direct dramatics, assemblies, publications, or forensics (i.e., English activities). None of them sponsored music activities. These assignments seem to suggest that it is reasonable for men interested in coaching football and boys' basketball to emphasize, in college, participation in these sports and related physical activities rather than participation in English and music activities.

The next group, male sponsors of minor physical activities, included 17 men who coached minor sports such as tennis, golf, and soccer, or had administrative responsibilities for athletic programs. Although baseball is often regarded as a major sport, three men who coached baseball were classified as male sponsors of minor physical activities; two were assistant coaches and one sponsored an eighth-grade squad. The men in this group did not sponsor any publications or music activities. Very few of them mentioned responsibility for assemblies or dramatics. On the average, each man was in charge of one physical activity and one other activity. Slightly more than half of these men had charge of homerooms. These activity assignments also suggest that it is reasonable for some male prospective teachers to specialize in physical activities rather than in English or music activities.

The third group, female sponsors of major physical activities, included 34 women who were responsible to a major degree for girls' physical activities, girls' sports, or girls' intramural programs. More specifically this group was composed of coaches of at least two of these activities: girls' basketball, cheerleading, hockey, modern dance, and softball, or one of

[2] W. Scott Smith, *The Placement of Inexperienced Teachers in New Jersey High Schools in Relation to Their Academic Preparation*. Doctor's dissertation. New York: New York University, 1937. p. 102. (Unpublished)

[3] The physical activities sponsored by beginning teachers are listed at the end of this article.

the activities listed above plus archery or tennis. On the average each one of these women sponsored four physical activities. Only occasional sponsorship of English or music activities was reported. About one-fifth of these teachers had responsibilities for homerooms. About half of them sponsored civic, social, or club activities. Each of two of these women said they sponsored 10 activities! These assignments seem to suggest that some women should emphasize participation in physical activities as part of their preparation for sponsorship.

The fourth group, female sponsors of minor physical activities, included 21 women who coached at least one physical activity for girls or directed the athletic association. One exception to this arrangement was a beginning teacher who directed a music festival and the school operetta in addition to one "physical" activity—cheerleading. No teacher included in this

TABLE 1

Average number of physical activities in which participation, in high school and college, was reported by sponsors

ACTIVITY SPONSOR GROUPS	AVERAGE NUMBER OF PHYSICAL ACTIVITIES IN WHICH PARTICIPATION WAS REPORTED	
	High School	College
Coaches of football and boys' basketball	2.7	2.7
Male sponsors of minor physical activities	1.5	1.7
Female sponsors of major physical activities	2.4	4.6
Female sponsors of minor physical activities	1.8	3.1
Other sponsor groups	0.6	0.6
All sponsors	1.2	1.5

group directed publications or music activities and only a few had responsibilities for assemblies or dramatics. About half of them sponsored homerooms; about half directed civic, social, or club activities. These activity assignments seem to suggest that some prospective teachers should specialize in preparing to coach physical activities.

Preparation through Participation in Activities

Subsequent paragraphs present analyses of beginning-teachers' participation in activities when they were students in high school and in college. Table 1 displays the average number of physical activities in which participation, in high schoo' and college, was reported by sponsors.

Greater than average participation in physical activities was indicated by beginning teachers who later had responsibilities for such activities. All teachers reported taking part in an average of only 1.2 physical activities in high school. Forty-six coaches of football and boys' basketball listed 126 physical activities or an average of 2.7 activities per man. Female sponsors of major physical activities averaged 2.4 activities; female sponsors of minor physical activities, 1.8; and male sponsors of minor physical activities, 1.5.

Greater than average participation in college physical activities was indicated by those who later coached similar activities. The average number of physical activities reported by all teachers was 1.5. Women sponsors of major physical activities averaged 4.6 activities, more than three times the average for all beginning teachers. For women sponsors of minor physical activities a mean of 3.1 was computed; for coaches of football and boys' basketball, 2.7; for men sponsoring minor physical activities, 1.7.

Forty-two men stated that they played football in college. Thirty of these men later coached football when they were beginning teachers in high school. Five football coaches did not list this sport as an activity in either high school or college. Of these five, one majored in physical education; another played "all major sports", and a third reported he took part in "intramurals" in high school. Apparently the other two men had no specific preparation either through formal course work or by participation in football.

Of the 26 men who coached boys' basketball, 21 reported playing the game in college. Three basketball coaches did not list this sport as an activity in either high school or college. Two of these three reported "intramurals" and the third listed "all major sports." However, one coach claimed that he had not played basketball previously.

Thirty-four men reported baseball as an activity in college. As beginning teachers, nine of these men later coached baseball. Six baseball coaches did not list this sport as an activity in either high school or college. One said he played baseball at the YMCA; four others indicated they may have had some experience since they listed as high-school or college activities "all athletics," "major sports," "softball," or "sports." One gave no hint of his training or experience in baseball.

On the basis of these data it seems apparent that certain predictions can be made. If a man played football in college and was later employed as a secondary-school teacher, the chances seem to be about three to one that he will coach football during his first or second year of teaching. If a man played basketball or baseball in college and was later employed as a secondary-school teacher, the chances seem to be considerably smaller that he will coach either of these sports.

In general, participation in physical activities was less associated with participation in English activities or with participation in music activities. Hayes[4] found a similar tendency for high-school pupils to specialize in certain types of activities. As beginning teachers progressed from high school to college, to practice teaching, and then to their first professional employment they tended to specialize more in one of these types of activities: physical, English, or music.

As a group, women sponsors of physical activities reported much greater

[4] Wayland J. Hayes, *Some Factors Influencing Participation in Voluntary School Group Activities*. Contributions to Education, No. 419. New York: Bureau of Publications, Teachers College, Columbia University, 1930. p. 75. (A case study of one high school.)

participation in this type of activity in college than in high school. Women in charge of major physical activities averaged, in college, 4.6 physical activities, or almost twice the mean number of similar activities in high school. Women responsible for minor physical activities likewise reported more physical activities in college (3.1) than in high school (1.8).

In general it seems apparent that practically every coach of a competitive sport needed to play the game in high school or in college in order to qualify for appointment as coach. In almost all cases the men in charge of football and basketball reported participation in the sport they coached. As a group, sponsors of physical activities seemed to participate in physical activities rather than in English or music activities.

TABLE 2

Number of teachers in each sponsor group who reported certification in each subject field

ACTIVITY SPONSOR GROUPS	NO. IN GROUP	SUBJECT FIELDS												
		Art	Commercial	English	Guidance	Home Economics	Industrial Arts	Language, Foreign	Mathematics	Music	Physical Education	Science	Social Studies	Others
Coaches, football & basketball	46	0	4	10	0	0	2	4	12	0	17	21	26	0
Male sponsors, minor physical	17	1	2	3	0	0	3	1	4	0	2	4	4	2
Female sponsors, major physical	34	0	0	6	0	0	0	3	1	0	28	7	9	0
Female sponsors, minor physical	21	0	5	8	0	3	0	3	1	0	5	2	8	1
Other sponsor groups	205	8	32	89	2	24	9	26	26	21	1	48	67	5
All sponsors	323	9	43	116	2	27	14	37	44	21	53	82	114	8

Note: This table should be read as follows: Of the 46 coaches of football and boys' basketball, none reported certification in art. Four said they were certified in commercial subjects and 10 in English.

Certification of These Teachers

Beginning teachers might be prepared for their assignments as activity sponsors through the successful completion of subjectmatter courses. Subsequent paragraphs present an analysis of the certification reported by sponsors of physical activities. Table 2 shows the number of times each field of certification was listed by teachers in each sponsor group.

Seventeen of the 20 men certified in physical education coached physical activities. Two other men certified in physical education were in charge of at least one physical activity. All 33 women certified in this field were responsible for at least one physical activity.

Only about one-third (17 of 46) of the coaches of football and boys' basketball were certified in physical education. These coaches were certified in social studies or in science more often than in physical education. About

half the men certified in science (21 of 44), mathematics (12 of 26), or social studies (26 of 63) were coaches of football and/or basketball.

Of the 17 men who sponsored minor physical activities, only two were certified in physical education.

Twenty-eight of the 34 women who sponsored major physical activities were certified in physical education. Other teachers in this group were certified in social studies, English, science, languages, and mathematics.

These data seem to indicate that beginning teachers who were certified in physical education sponsored activities related to that subject field. On the other hand, teachers licensed to teach academic subjects (English,

TABLE 3

Number of teachers in each sponsor group who reported teaching in each subject field

ACTIVITY SPONSOR GROUPS	NO. IN GROUP	SUBJECT FIELDS												
		Art	Commercial	English	Guidance	Home Economics	Industrial Arts	Language Foreign	Mathematics	Music	Physical Education	Science	Social Studies	Others
Coaches, football & basketball	46	0	2	3	0	0	1	0	10	0	12	10	16	0
Male sponsors, minor physical	17	1	3	0	0	0	3	2	4	0	1	3	2	1
Female sponsors, major physical	34	0	0	3	0	0	0	2	1	0	30	0	2	0
Female sponsors, minor physical	21	1	5	5	0	3	0	2	2	1	4	3	0	0
Other sponsor groups	205	8	27	30	3	24	9	10	21	19	0	28	36	6
All sponsors	323	10	37	41	3	27	13	16	38	20	47	44	56	7

Note: This table should be read as follows: Of the 46 coaches of football and boys' basketball, none was teaching art but two taught commercial subjects and three English.

social studies, languages, mathematics, science) coached all sorts of pupil activities, including sports and other physical activities. Beck[5] found that playing on college teams was commonly a factor in the background of male coaches regardless of the amount of their professional preparation in physical education. Apparently participation in a sport was regarded as more desirable preparation for coaching that sport than was certification in physical education.

Teaching Assignments of These Coaches

Subjects taught by beginning teachers were classified into the same fields used in the previous section. Table 3 summarizes the number of teachers

[5] Eugene E. Beck, *A Proposed Professional Curriculum for the Preparation of Men Physical Education Teachers at the University of Wisconsin*, Doctor's dissertation. Columbus: Ohio State University, 1949. p. 148. (Unpublished)

in each sponsor group who, at the time of the survey, were teaching at least one class in each field. No attempt was made to distinguish between a single class and a full load in the field. Subsequent statements are based on information about sponsors' teaching assignments.

All of the teachers who were instructing physical education classes were responsible for at least one physical activity.

Sixteen of the 46 coaches of football and basketball taught social-studies classes; only 12 instructed in physical education. Ten coaches taught mathematics and 10 science. The men who directed minor physical activities taught classes in many fields including art, commercial art, industrial arts, languages, mathematics, science, social studies, and vocational agriculture. Only one of these men instructed in physical education.

Thirty of the 34 female sponsors of two or more physical activities were teachers of physical education. Women who directed only one physical activity were teaching classes in a number of different fields. Commercial subjects and English were each taught by five of these teachers; physical education, by four.

In general it seems that teachers of special subjects sponsored activities closely related to their classes. Teachers of academic subjects, on the other hand, did not appear to sponsor activities closely related to their teaching assignments.

College Programs

Of the 22 colleges and universities surveyed in this study, 11 institutions offered opportunities for both men and women to major in physical education. One college provided women an opportunity to major in physical education. Another confined its student body to men some of whom could elect physical education as a minor. Other colleges had limited offerings in this field; two did not grant diploma credit for the required work in physical education.

According to Michaelis,[6] practically all state universities offered preparation in physical education. In 1949 he found 43 of the 44 institutions provided courses for men; 42 for women.

In this study, two or more colleges provided formal instruction in sports such as baseball, basketball, field hockey, football, soccer, softball, and track and field. In addition other activities were studied in physical education courses.

No one physical activity was listed by all colleges surveyed. However, more than half of these 22 colleges provided opportunities for prospective teachers to participate in baseball, basketball, football, swimming, tennis, and track. More than 20 different physical activities were reported by each of three institutions.

[6] John U. Michaelis, *An Overview of Current Practices in the Teacher Education Programs of State Universities*. Berkeley, California: School of Education, University of California, May 1948. p. 7. (Unpublished manuscript)

There seemed to be opportunity to participate in physical activities although some colleges lacked variety in the offerings. Apparently students majoring in physical education were prepared to coach related activities through formal instruction in courses and through participation in activities. Several colleges made definite provision to have prospective teachers help coach athletics or assist in other ways with the management of sports.

Each prospective teacher studying in the state teachers colleges of Pennsylvania was required to participate in at least one extracurricular activity while enrolled in the institution. This was part of the graduation requirement prescribed by the Board of Presidents.[7] One of these colleges required each student to "participate in the activities of a club for one semester of each of the four years on campus."

At one university all students majoring in physical education, health, and recreation were required to attend two camp sessions at the university camp as a part of their four-year training program. Two other universities provided practice in coaching as a part of the program for students majoring in physical education. Two institutions expected these students to assist in administering the physical education and sports program of the college and of a near-by high school. College officials recommended that men participate as members of college athletic teams and that women take part in extracurricular sports and dance clubs. One college required all men students in health and physical education to participate in six varsity sports over a period of four years. By participation was meant active membership on a varsity squad for the entire season of that sport.

Some Implications of This Study

These implications seem to emerge from the findings reported above.

In general three types of pupil activities seemed to be mutually exclusive: physical, English, and music activities. A teacher assigned to coach an activity of one type rarely was in charge of activities classified under either of the other two headings. These areas seem to suggest types of activities for which prospective teachers might specialize in addition to preparing to teach certain subject fields. For example, to the extent that discovered practice can be trusted, some students might reasonably participate in physical activities to the exclusion of dramatics, forensics, publications, or music groups. Other students might participate solely in English activities or in music groups. All should take part in civic, social, club, or departmental activities. Needless to say, teacher-training institutions should provide appropriate preparation for sponsoring pupil activities.

Beginning teachers certified in physical education coached activities related to that subject field. These men generally coached football, boys' basketball, and some baseball. These women directed two of these physical activities: girls' basketball, cheerleading, hockey, modern dance, softball,

[7] Letter of Henry Klonower, director, Teacher Education and Certification, Department of Public Instruction, Commonwealth of Penn., August 25, 1949.

archery, tennis. College instructors of physical education should provide systematically for preparing prospective teachers of physical education to sponsor these activities.

About half of the men certified in science, mathematics, or social studies were coaches of football and/or boys' basketball. Therefore, it seems reasonable to allow college men to elect courses in coaching football, or basketball, if they (a) play on these intercollegiate teams and (b) are not majoring in physical education.

Practice teaching offers unusual opportunities for each prospective teacher to observe master teachers who sponsor activities, to practice methods and principles previously learned about supervising activities, and to become familiar with the varied parts of the school program. College authorities might utilize this experience more effectively for preparing activity sponsors.

It seems that systematic advisement and supervision of prospective teachers by college authorities would make it possible for these college students to take formal courses and participate in college activities in order that they might be better qualified to sponsor activities. In college there exist activities and courses that are not utilized to the fullest extent to train coaches and other sponsors of physical activities.

Physical activities sponsored by men

Following each activity is the number of times beginning teachers reported sponsoring this activity.

Football	40
Basketball	26
Baseball	16
Track	10
Sports club	5
Wrestling	3
Athletic club	2
Boys intramurals	2
Golf	2
Soccer	2
Tennis	2
Volleyball	2
Athletic association	1
Archery	1
Badminton	1
Basketball club	1
Basketball referee	1
Bleacher committee	1
Booster club	1
Bowling	1
Cross country	1
Football equipment	1
Gym exhibit	1
Leaders club	1
Ping pong	1
Punch ball	1
Secretary of athetics	1
Sale of athletic tickets	1
Softball	1
Square dancing	1
Swimming	1
Varsity club	1

Physical activities sponsored by women

Following each activity is the number of times beginning teachers reported sponsoring this activity.

Basketball	25
Cheerleaders	21
Softball	20
Hockey	16
Modern dance	10
Tennis	8
Bowling	7
Leaders club	7
Volleyball	6
Archery	6
Girls intramurals	6
Athletic association	4
Soccer	3
Swimming	3
Dancing club	2
Gym exhibit	2
Sports club	2
Booster club	1
Fencing	1
Life saving	1
Officials club	1
Ping pong	1
Punch ball	1
Rockettes	1
Sports day	1
Square dancing	1
Ticket taker	1
Track	1
Water ballet	1

Physical Education and ROTC in American Colleges and Universities

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In August, 1950, the writer conducted a survey of American colleges and universities which had ROTC units in an effort to find out how many institutions permitted the substitution of ROTC for physical education. The April, 1950, issue of *Higher Education*[1] was listed as a special number and was devoted entirely to a discussion of the Reserve Officer Training Programs. This publication listed 231 institutions as having ROTC units, but on the returned questionnaires in the present study, three indicated that they did not have an ROTC unit. Apparently the units in these institutions had been discontinued since the collection of data for use in *Higher Education*.

According to this issue of *Higher Education*, there were 369 service units located in colleges and universities, which were distributed as follows: 190 Army units, 127 Air Force units and 52 Navy units. One hundred and eight institutions had more than one unit, but only 30 institutions had units representing all three services. Military training was compulsory in 120 institutions. Of all 11,364 men who were commissioned in 1949 from the academies and the ROTC units, 10,000 came from the ROTC units. It is estimated that the cost to the government in 1951 for maintaining units in both secondary schools and institutions of higher learning will be about $44 million, exclusive of the salaries paid to military personnel assigned to service in the units. Institutions maintaining ROTC units represent about 13% of the 1808 institutions of higher learning in the United States. At the present time applications are pending from several hundred additional institutions which indicates a possibility of an increase in the number of units in the future.

There is still a wide divergence in methods of training, selection of student personnel, and amount of credit granted for participation in the program. Credit granted ranges from full credit in some institutions to no credit at all in other institutions for doing essentially the same amount of work. If pending congressional legislation is enacted these conditions will tend to be corrected by effecting more standardized programs throughout the various services.

Of the 231 questionnaires sent to the institutions listed in *Higher Educa-*

[1] U. S. Office of Education, Federal Security Agency. *Higher Education*, April 15, 1950.

tion as having ROTC units, 215, or 93%, were returned. The questionnaires were sent to the registrars of the various institutions and requested information on the following items: (a) Did the school have a required physical education program? if so, (b) How many years were required? and (c) Did the institution permit the substitution of ROTC for physical education. Table 1 shows the distribution of schools according to the number of years physical education is required.

Of the 215 schools reporting on the questionnaire, 212 maintained at least one ROTC unit and 3 indicated that they had no unit. Of the 212 maintaining ROTC units, 180, 85%, had a required physical education program ranging from one year, or fractional part thereof, to four years. Two schools reported a flexible arrangement whereby students may be excused from participation in physical education after they have demonstrated abilities in certain fitness and motor tests. Of the 180 schools having a physical education requirement, 104 (58%) do not permit the substitution of ROTC for physical education. Eight schools, or 4%, followed a plan of partial substitution whereby ROTC could be substituted for part of the physical education requirement. In one of these schools students in the Army ROTC unit were allowed to substitute that activity for physical education while students in the Navy unit were required to take both courses. A few institutions with a number of colleges permit substitution in some divisions and not in others; e.g., two schools permit engineering students to substitute ROTC for physical education while students in other divisions take both courses. Sixty eight institutions, or 38% of those having a physical education requirement, permit full substitution of ROTC for physical education.

TABLE 1

	NO REQUIREMENT	ONE YEAR REQUIREMENT	TWO YEAR REQUIREMENT	THREE YEAR REQUIREMENT	FOUR YEAR REQUIREMENT	VARIABLE REQUIREMENT
Number of schools......	32	41	119	5	13	2

All 48 states and the territories of Alaska, Hawaii, and Puerto Rico, as well as the District of Columbia, had at least one college or university with an ROTC unit. Within 15 of the states and two territories no institutions permit substitution of ROTC for physical education. Institutions in these areas total 36. There appears to be no recognizable geographical pattern regarding the location of these states as they are rather well-distributed throughout the country. Neither does there appear to be any relationship between the type of service unit in an institution and its policy toward the substitution of ROTC for physical education.

Summary

1. Of the 231 institutions surveyed in this study, 215, or 93%, answered the questionnaire.

2. Two hundred twelve institutions reported having ROTC units while three schools indicated that no units existed on their campus.
3. Participation in the military program is compulsory in 120 institutions.
4. One hundred eighty schools, or 85% of the schools having ROTC units, have a required physical education program.
5. Of the 180 schools having a required physical education program, 104, or 58%, permit no substitution of ROTC for physical education. Eight schools, or 4%, permit partial substitution, while 68 schools, or 38%, permit full substitution of ROTC for physical education.

Recommended Democratic Practices in the Preparation of Women Teachers of Physical Education: A Checklist for Selfstudy

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AS A result of interest and concern stimulated by publication of the report of the President's Commission on Higher Education, *Higher Education for American Democracy*,[1] the members of the National Association for Physical Education of College Women requested their Committee on Professional Leadership to initiate and guide a program of self-study designed to bring practices in college physical education departments more nearly in line with democratic principles. Following a preliminary investigation in 1948–49 in which staff groups were asked to report those practices in their own departments which seemed to show promise of implementing democratic belief, the Committee on Professional Leadership was asked to continue the study program, supplying more explicit guidance to participating departments.[2] *Purpose of the Study, 1949–1950.* The purpose of the study undertaken by the Committee on Professional Leadership for the academic year 1949–50 was to provide the guidance requested by the Association through the development of criteria in the form of a checklist by means of which staff groups might study their own practices in teacher preparation in relation to democratic belief.

Procedure

There were two major problems involved in providing the requested guidance to the members of the Association:

1. The provision of a definitive working statement of democratic belief.
2. The selection of practices for implementation of that belief.

Following the pattern used by the sub-committee of the Committee on

[1] President's Commission on Higher Education. *Higher Education for American Democracy*, Washington, D. C.: Superintendent of Documents, Government Printing Office, 1947.

[2] National Association for Physical Education of College Women. *Practices of Promise in the Understanding and Use of the Democratic Process.* Boston, Mass.: The Association, April 1949.

Standards and Surveys of the American Association of Teachers Colleges in the study of *School and Community Laboratory Experiences in Teacher Education,*[3] questionnaires to juries of experts were utilized in undertaking both tasks.

In meeting the problem of developing a working statement of democratic belief, it was judged that the members of the President's Commission on Higher Education would constitute a jury of experts interested in the problem and fully competent to judge the adequacy of the proposed working statement. The elements of democratic belief developed in the 1948–49 study were used as a base and were expanded into a tentative statement. Seventeen of the 29 members of the President's Commission reacted favorably to the statement, and their ideas were incorporated to form the final statement as it appears on the checklist.

In selecting the practices for implementation of belief, the ideas expressed in the 1948–49 study were drawn out and expanded. The 54 college staff groups which responded so generously in that study were then asked to indicate their degree of endorsement of each practice. Thirty-four of the 41 colleges having teacher education programs responded to the questionnaire, and those practices which were endorsed by at least 75% of the respondents, were incorporated into the checklist.

Results of the Study

The study resulted in the accompanying checklist to be used by individuals or staff groups in studying their own practices in teacher preparation.

Summary

The study reported in this article was conducted at the request of the membership of the National Association for Physical Education of College Women and was sponsored by its committee on Professional Leadership. The resulting checklist was developed with recognition that a large part of its value rests in the process of selfstudy for which it was designed. In order to assist staff groups and individuals in its use, the following procedure is suggested:

1. Check each practice in the appropriate column.
2. Identify areas of practices or isolated practices where your program does not seem to meet proposed standards.
3. Study areas of practices in which your program seems to be weak to determine whether they are desirable or applicable in your situation.
4. Try some of the proposed practices not now in operation in your program, and continue to add new ones as they evolve from your study and self-evaluation.

[3] Sub-Committee of the Committee on Standards and Surveys. *School and Community Laboratory Experiences in Teacher Education*, New York: American Association of Teachers Colleges, 1948.

GUIDE TO SELF-EVALUATION: A CHECKLIST

I. *Belief in the Uniqueness and Worth of Each Individual:*

Democracy imposes no civic, political, social, or economic liabilities or restrictions upon individuals or groups because of race, religion, national origin, or economic status. Rather, it draws its inclusive line around all peoples. It affirms the fact that each person has unique characteristics, and recognizes that it is the diversity of individual contribution that makes for ultimate group and community well-being.

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Sometimes	Never
A. *Acceptance of Self* In order that each person may participate freely in democratic living, he needs faith and reassurance of his own ability and obligation to contribute to the common welfare.	1. Each student receives the personal attention of a staff member who acts as her advisor in personal and academic matters.			
	2. Whenever possible, arrangements are made for mutual choice on the part of both student and advisor, with the advisor retaining the right to decline to work with a given student.			
	3. Each student is evaluated in terms of the demands of the profession by all the instructors with whom she works.			
	a. Evaluation is based on factual description of behavior rather than on staff interpretation.			
	b. Staff evaluation of each student is interpreted with the help of the student in personal conference with the advisor.			
	c. Objective value judgments are made relative to specific behavior and to the demands of teaching, rather than the student's worth as a person.			
	4. A cumulative record file is kept for each student.			
	a. The student knows what materials are placed in her file and understands the reasons for their inclusion.			
	b. A variety of effective tools are collected and used as bases for guidance, such as:			
	(1) Standardized tests—selected, administered, and interpreted by trained guidance personnel.			

GUIDE TO SELF-EVALUATION: A CHECKLIST—(*Continued*)

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Some-times	Never
A. *Acceptance of Self*—(Continued)	4. b.—(Continued) (2) Anecdotal records, ethically used.			
	(3) Qualified consultant service.			
	(4) Voice recordings.			
	(5) Pictures and motion pictures.			
	5. Commendation for unusual individual or group contribution is freely expressed by both students and staff.			
	a. When appropriate, personal notes of commendation are sent by staff to students.			
	b. Verbal expression of commendation is encouraged among students.			
	c. The departmental newspaper cites the achievements of students and staff.			
	6. An effort is made to understand and assist students whose scholarship is low.			
	a. Students are referred to sources of expert help in solving academic and personal problems.			
	b. Students are encouraged to form special study groups to assist students making poor grades.			
	c. Students' programs are adjusted to meet individual needs and circumstances over the period of college education.			
	d. Students are encouraged to evaluate themselves objectively in the light of accepted professional and personal standards.			

GUIDE TO SELF-EVALUATION: A CHECKLIST—(*Continued*)

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Some-times	Never
A. *Acceptance of Self*—(Continued)	6.—(Continued) e. Effort is made to redirect students who are not meeting the requirements for teaching without inference of personal failure.			
	7. Many opportunities for self-expression are provided for both students and staff.			
	8. Students are encouraged to clarify their own life goals, both personal and professional, and to relate present actions to future goals.			
	a. Students are encouraged to think of out-of-school experiences as important to growth.			
	b. Students are offered guidance in social skills.			
	c. Students are guided in the understanding of their own bodies, their builds, their potentialities, their limitations, their sex, etc.			
B. *Acceptance of Differences* Each person needs to recognize and appreciate the ideas and competencies of others as complementing his own. Responsibility, therefore, must be willingly assumed, and shifts among all people, depending upon their expertness in meeting the particular demands of the job to be done.	1. The student is guided in the selection from a wide variety of experiences inside and outside the department to meet her own needs and interests.			
	2. Conscious effort is made to foster appreciation and understanding of differences among individuals and groups.			
	a. Opportunity is provided to study in the areas of anthropology, sociology, psychology, etc., with content related specifically to the field of physical education.			
	b. A variety of methods of presentation are used to facilitate understanding of others, such as films, speakers, reading, etc.			

GUIDE TO SELF-EVALUATION: A CHECKLIST—(*Continued*)

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Sometimes	Never
B. *Acceptance of Differences*—(Continued)	2.—(Continued) c. A variety of planned and guided field and laboratory experiences are provided in which students may learn about people unlike the self.			
	d. The program provides opportunity for students to work with groups of various age, racial, and socio-economic levels.			
	(1) Students are guided into experiences which seem to give most promise of meeting their individual needs.			
	(2) Experience is provided for each student by placing her in a working situation with an expert group work leader.			
	3. The program provides for experiences in and study of functional member roles in group process.			
	4. Student accomplishment is evaluated by students and staff in relation to individual capacities and needs and to the demands of the profession, rather than in relation to preconceived standards.			
	5. Students evaluate practices in school and out-of-school recreation and competition on the basis of equality of opportunity for all groups.			
	6. Students participate in folk and national dance activities with the conscious purpose of gaining better understanding of other cultures.			
C. *Empathy as a Plus Value Beyond Tolerance and Sympathy.* Acceptance of self and others should go	1. Effort is made to sensitize students to the needs of others through emphasis on basic human personality needs as a primary concern.			

GUIDE TO SELF-EVALUATION: A CHECKLIST—*(Continued)*

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Sometimes	Never
C. *Empathy as a Plus Value Beyond Tolerance and Sympathy*—(Continued) beyond an intellectual concept. The ability to *feel* the needs of others as acutely as one's own is basic to action for the good of all, and should increase with maturation.	2. Staff and student approval is accorded behavior evidencing sensitivity to the needs of others.			
	a. Students are given opportunity and guidance in working directly with the handicapped in a clinical situation on a voluntary basis.			
	b. Opportunity is given students to see and feel the needs of underprivileged groups.			
	3. Students study the bases and manifestations of tensions within their own groups as illustration of the conflict of member roles and needs.			
	a. Students are encouraged to analyze their own behavior in many group situations, and to work for mutually supportive relationships.			
	b. Students are encouraged to understand and appreciate persons as competent or more competent than themselves, and to work constructively with them.			
	c. Students are encouraged to understand the problems of status persons within their groups and to make realistic adjustment of their demands on those persons.			

GUIDE TO SELF-EVALUATION: A CHECKLIST—(*Continued*)

II. ***Responsibility for One's Own Actions:***

The purpose of a democracy is never to fit all people to one mold, but rather to provide a maximum of wholesome choices, so that any individual may direct his own actions to most adequately meet his rationally evaluated needs within the framework of his role as a responsible and constructive element in society. In so doing, each individual has responsibility to base his actions on best available foundations—both his own considered judgment and evaluated authoritative opinion.

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Sometimes	Never
A. *Acceptance of Mature Action as a Goal* The development of each person's powers of thinking and doing is not to be left to chance. Consistently mature behavior needs to be the consciously accepted goal of democratic living and of all education.	1. Students and staff plan together for maximum opportunity for the development of self-direction.			
	a. Each student, with her advisor or other staff member, evaluates her present status relative to the demands of the profession.			
	b. Students set their own individual and group goals with guidance of the staff.			
	c. Students are guided in planning their own procedures for reaching personal and professional goals.			
	d. Students and staff share in the responsibility of individual and group evaluation.			
	2. Students are encouraged to think of themselves as professional people throughout the period of college education.			
	a. Students are encouraged to join and participate actively in professional organizations.			
	b. Students are encouraged to broaden their experience by joining the non-professional groups.			
	c. Students are encouraged to develop their own professional libraries and teaching materials.			
	d. Students are educated to locate, request, and use resources when needed.			

GUIDE TO SELF-EVALUATION: A CHECKLIST—(*Continued*)

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Sometimes	Never
A. *Acceptance of Mature Action as a Goal*—(Continued)	2.—(Continued) e. Students evaluate the role of the expert in a democracy, learn to respect the value of information and experience available to them.			
	f. Students are encouraged to do independent study to meet their own individual needs.			
	g. Students are encouraged to use a professional library in the department.			
	3. Opportunity and assistance are provided to enable students to assume voluntary responsibility in professional and related areas.			
	a. Students are encouraged to officiate at playdays and other athletic events.			
	b. Students are encouraged to assume leadership in campus and community activities.			
	c. Students are encouraged to accept approved summer camp positions.			
	d. Students are given responsibilities in the departmental organization.			
	e. Students maintain exhibits and bulletin boards.			
	f. Students maintain the departmental library with the guidance and assistance of the staff.			
	4. Students are taught to try to discriminate between fact and propaganda.			
	5. Students are encouraged to base their action on best available information.			

GUIDE TO SELF-EVALUATION: A CHECKLIST—*(Continued)*

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Sometimes	Never
A. *Acceptance of Mature Action as a Goal*—(Continued)	5.—(Continued) a. Students are encouraged to synthesize facts and principles from other fields as a working basis for physical education practices.			
	b. Students are exposed to conflicting points of view and are stimulated to do independent thinking.			
	6. Students are expected to assume responsibility for completing their work.			
	7. Students are encouraged to evaluate themselves and their actions in relation to the demands of teaching in a democracy.			
	a. Students are encouraged to effect a healthy balance between introvertive self-criticism and extrovertive insensitivity.			
	b. Students are helped to discover ways of meeting and coping with difficult situations, both personal and professional.			
B. *Willingness to Accept the Responsibility of One's Action Without Alibi or Evasion* Recognition of responsibility for self-directed activity demands constant foresight, and evaluation of potential outcomes in terms of acceptable democratic values.	1. Students and staff consistently evaluate their activities in the light of objectives.			
	2. Students are encouraged to request individual evaluation by students and staff.			
	a. Students arrange for group evaluation of each member with provision for individual differences in readiness to accept help.			
	b. Students are helped to interpret group comment about themselves.			

GUIDE TO SELF-EVALUATION: A CHECKLIST—(*Continued*)

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Some-times	Never
B. *Willingness to Accept the Responsibility of One's Action Without Alibi or Evasion*—(Continued)				
	3. Students are allowed to fail in group and individual undertakings if they will profit from failure, and if the failure does not jeopardize the welfare of others.			
	a. Effort is made to help students think through potential outcomes of their action.			
	b. Students are helped to search for reasons behind varied outcomes of action and to plan for improvement.			
	4. Students are reminded that voting for a project implies willingness to share in the work and results involved.			
	5. Relations between player and official are examined in the light of the concept of no alibi or evasion.			
C. *Sensitivity to the Effects of One's Actions Upon Others* In a democracy, values should be concerned primarily with the welfare of every individual, so that the beneficent effects of one's action upon the general welfare is a prime consideration.	1. Students evaluate their own behavior for its effect on other individuals with guidance by the staff.			
	2. Students are encouraged to analyze and understand professional attitude and appearance and to work toward their own improvement motivated by professional ethics rather than by fear of consequences.			
	3. Students study and practice various member roles in group process with awareness of their effects upon group action.			
	4. Students are given guided practice in the observation of symptomatic behavior.			
	a. Classes study group dynamics as an aid to effective group operation.			

GUIDE TO SELF-EVALUATION: A CHECKLIST—(*Continued*)

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Some-times	Never
C. *Sensitivity to the Effects of One's Actions Upon Others*—(Continued)	4.—(Continued)			
	b. Students have guided observation experience in groups of various kinds.			
	c. Students have learning experiences in counseling and guidance with recognition of the potential dangers of amateur guidance.			
	5. Individual choices are made in terms of group and individual values and needs.			
	6. Students study and compare competitive and cooperative practices in groups in different cultures, in different fields, and in their own field for their effects upon personality.			

III. *Belief and Skill in Cooperative Action:*

When each individual is faced with the responsibility of thinking and acting for his own good and that of others, skill and belief in group thinking, planning, and acting is a necessity for every person.

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Some-time	Never
A. *Belief that Planning and Working Together is an Effective Method, Evidenced by Habitual Use of Cooperative Methods. Belief in the Emergent Results of Group Thinking and Action* Democracy maintains that groups are capable of combining the contributions of all their members to reach a solution which best reconciles the needs of all. This belief should be evi-	1. Students and staff work together toward improving the curriculum and departmental operation with limiting factors clearly defined.			
	a. Students are invited to attend staff meetings when their presence will facilitate understanding.			
	b. Communication channels between students and staff are open and practical.			
	c. Student-staff committees evaluate and consider revision of the curriculum.			

GUIDE TO SELF-EVALUATION: A CHECKLIST—(*Continued*)

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Some-time	Never
A. *Belief that Planning and Working Together is an Effective Method, Evidenced by Habitual Use of Cooperative Methods. Belief in the Emergent Results of Group Thinking and Action*—(Continued) denced by willingness to share divergent viewpoints and to use group action to solve group problems, with both cooperative competition and competitive, cooperation of the ideas involved in process of decision making.	1.—(Continued) d. Committees of students and staff evaluate and revise departmental policies which pertain to the student group. e. Opportunities to work with staff on considerations of policy and curriculum are spread among all students.			
	f. Course procedure is planned, shared, and evaluated by all students or representatives of all students involved, to the degree to which such a practice is meaningful.			
	g. Opportunities are provided for graduate students and alumnae to share in departmental thinking.			
	h. Staff are willing to accept individual expression of student opinion without reflection upon the student.			
	2. Students and staff meet informally to discuss individual and group ideas, problems, and feelings.			
	3. Students and staff share in social undertakings.			
	a. Groups of students and staff enjoy friendly competition when appropriate.			
	b. Staff members attend and participate in student parties when appropriate.			
	c. Students and staff plan and carry out social functions together when appropriate.			

GUIDE TO SELF-EVALUATION: A CHECKLIST—(*Continued*)

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Some-times	Never
A. *Belief that Planning and Working Together is an Effective Method, Evidenced by Habitual Use of Cooperative Methods. Belief in the Emergent Results of Group Thinking and Action*—(Continued)	3.—(Continued) d. Men and women majors plan and conduct professional and social occasions together.			
	4. Professional courses are co-educational whenever such procedure does not jeopardize the achievement of goals.			
	5. A professional-social club is maintained by and for major students when it meets a student need.			
	a. The major club provides student advisors for new students.			
	b. The major club works with staff on orientation of new students.			
	c. Membership in the major club is open to all and attendance is voluntary.			
	d. In large departments, a major newspaper is used to facilitate intra-departmental communication.			
	e. The major club selects its own faculty advisor from among qualified staff who have expressed interest.			
	f. Men's and women's major clubs carry out some activities jointly.			
	6. When content and facilities allow, workshop and discussion sessions involving small working groups with shifting student leadership are used in major classes.			

ELEMENTS	PRACTICES	CONSISTENCY OF USE: Always	Some-times	Never
A. ***Belief that Planning and Working Together is an Effective Method, Evidenced by Habitual Use of Cooperative Methods. Belief in the Emergent Results of Group Thinking and Action***—(Continued)				
	7. Situations are administratively arranged to facilitate democratic action.			
	a. Ample staff and facilites are provided to allow for small classes.			
	b. Seating arrangements are flexible.			
	c. Time and facilities are scheduled in ample blocks.			
	d. Resource persons and materials are readily available.			
	e. Students are encouraged to help each other in acquiring understandings and skills.			
	8. Staff role ranges from leadership to membership in student working groups.			
	a. Staff members are free to contribute ideas when the need arises, but refrain from forcing their ideas on the group.			
	b. Consultants and resource persons are used after students develop power to initiate and conduct their group meetings.			
	c. Committee work, panels, and other group processes are carefully prepared, so that interchange of facts and ideas may produce creative results.			
	d. Group methods are supplemented by other procedures when necessary for achievement and satisfaction.			
	9. Opportunities are provided for student discussion of professional problems independent of staff.			

GUIDE TO SELF-EVALUATION: A CHECKLIST—(*Continued*)

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Some-times	Never
B. *Acceptance of Majority Rule* When unified action must result from controversy, the needs of most of the people should determine the decision.	1. Group decisions are made by vote when uniform action is necessary and consensus is impossible.			
	a. Officers, leaders, etc. are elected by the group concerned with understanding and responsibility.			
	b. Friction among students or among students and staff is settled by group discussion and agreement among those concerned.			
	c. Students learn how to work out acceptable compromises, so that group discussions may work toward consensus rather than split opinion.			
	2. Students are encouraged to think in terms of the social good in making individual decisions.			
	3. Minorities learn to accept majority opinion soundly based without resentment.			
C. *Protection of Minority Opinion* What is good or right for most people is not assumed to be "right" for all. Democracy admits the possibility of many different solutions. It recognizes the need for adjustment to protect minority rights and to meet minority needs.	1. General participation is encouraged in group discussions.			
	2. Staff members try to refrain from using status to influence group and individual decisions.			
	3. Students are encouraged to look for reasons for behavior in order to understand the action of self and others.			
	4. Whenever possible, majority and minority groups try to find common grounds for action.			
	5. Avenues are provided for minority expression and action.			
	a. Different levels of readiness and understanding are recognized by the use of sub-groupings.			
	b. Majority groups are encouraged to search for worth in minority opinion.			

GUIDE TO SELF-EVALUATION: A CHECKLIST—(*Continued*)

IV. *Awareness of Democratic Principles and of Ways They Are Evidenced in One's Actions:*

In order to live effectively within the framework of a democracy, each person needs to know and understand—both intellectually and emotionally—how to behave in a manner consistent with group values and standards of behavior when they exemplify democratic philosophy.

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Sometimes	Never
A. *Explicit Emphasis on Democratic Principles in Educational Experience* Democracy relies heavily upon the education of *all* of its people as the one force by which it evolves toward the perfect instrumentality to achieve the general welfare. Every student should experience—and *know* that he is experiencing—democratic principles as both method and content of the educative process.	1. The department declares itself as committed to the understanding, practice, evaluation, and perpetuation of democratic philosophy.			
	a. Provision is made in the curriculum for classes to discuss democracy as a way of living and teaching—its origin, principles, implications, problems, and implementation.			
	b. Students and staff evaluate teaching in terms of democratic principles.			
	c. Group and individual action is evaluated in terms of democratic principles. d. The curriculum provides opportunity for classes to study democratic philosophy, to compare it with other viewpoints, to work out ways to apply it to the physical education situation.			
	2. Content and procedure of major classes includes guidance to enable the individual to become more skilled in operating effectively in a democratic society.			
	a. Reading materials are provided on democratic philosophy and skills.			
	b. Provision is made in the curriculum for classes to become familiar with newer techniques, such as sociometry, group dynamics, etc.			
	c. Emphasis is placed on effective communication.			

GUIDE TO SELF-EVALUATION: A CHECKLIST—(*Continued*)

ELEMENTS	PRACTICES	CONSISTENCY OF USE		
		Always	Some-times	Never
A. *Explicit Emphasis on Democratic Principles in Educational Experience*—(Continued)				
	3. Work on curriculum construction is done explicitly within the framework of democratic spirit and principles.			
	4. Students examine non-democratic forces in campus and community life.			
	5. Interpretation of required courses is made on the basis of demands upon democratic citizens.			
B. *Emphasis on the Relationship of Beliefs to Action in Planning, Acting, and Evaluating* Each person should learn to base his actions upon socially defensible values which are understood and accepted by him. These values, whenever possible, should be reinforced by his experience in democratic living.	1. Students and staff have many opportunities to state their beliefs as a basis for planning, acting, and evaluating.			
	2. Students and staff are encouraged to explore the factual bases underlying their emotionalized beliefs.			
	3. Students and staff evaluate their work and re-plan on the basis of stated beliefs.			
	4. Effort is made to point up the relationship between the principles of learning, the scientific method, and democratic principles.			
	5. Students are encouraged to believe that their convictions are best proven right or wrong by putting belief into action.			
	6. Organizations, experiences, and materials are evaluated as to the degree to which they reflect democratic beliefs and practices.			

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A Comparison of Methods of Measuring Improvement

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THE interpretation of the improvement in scores obtained from two different administrations of a test presents a most difficult problem in any area of testing. Several methods of measuring improvement have been proposed to aid in this interpretation; however, there is no indication that a final solution has been achieved. As indicated by the current literature several different methods are still being used in studies dealing with the interpretation of improvement from an initial to a final test. It seems that there are major differences among many of these methods and that some, on the basis of logical reasoning, are inadequate.

It is therefore the purpose of this study to compare through the use of statistical procedures several different methods of measuring improvement. No attempt is made to establish the validity of any one method but rather to show the relationship or lack of relationship among methods that have been used.

Source of Data

The data upon which the comparisons in this study are based were obtained from the results of a research project directed by Brace (3) in the fall of 1944 with 100 junior high-school girls. The data selected from this project are from two tests designed to measure the improvement in the learning of gross bodily motor skills. These two tests are a ball bounce test and a target toss test.

The ball bounce test consisted of bouncing a volleyball on a softball bat as many times as possible while standing in a restricted area. The score was the total number of times the ball was hit during the trial. In the target toss test the subject tossed a basketball over a net at a horizontal target placed on the floor. Three concentric circles were used for the target, and each throw was scored in the usual manner for target throws with three, two, and one points being allowed for the inner, middle, and outer circles respectively. Three throws were allowed during a trial.

It will be noted that the scoring of these two tests differs in that the target toss has a fixed score of nine points as the highest possible score for each trial while the highest score for the ball bounce is infinity. For the purpose of this study the highest score made in any one trial by any individual was used as the highest possible score for one trial.

Each subject was allowed 30 trials on each of the learning tests, and scores were recorded for each of the trials. For the purpose of this study an initial score and a final score were selected from the 30 trials. The initial score consists of the sum of the first five trials and the final score is the sum of the best five of the last 25 trials. The highest possible score for the target toss for five trials is 5 × 9 or 45, and the highest possible score for

TABLE 1

Means, Standard Deviations, Coefficients of Variation and Ranges

	BALL BOUNCE				TARGET TOSS			
	Mean	SD	CV	Range	Mean	SD	CV	Range
Difference in raw scores	21.26	15.39	72	1–85	13.48	5.06	38	0–27
Difference in T-scores	41.70	30.25	73	2–167	22.60	8.62	38	0–46
Percent gain over initial test	167.90	107.48	64	7–620	86.68	72.64	84	0–450
Percent gain of possible gain in raw scores	17.70	13.32	75	1–70	52.02	16.11	31	0–80
Percent gain of possible gain in T-scores	17.60	13.27	75	1–70	51.84	16.06	31	0–79
Increased increment	13.74	12.49	91	1–70	21.75	7.60	35	0–37
Absolute zero scale	55.91	52.18	93	2–271	29.05	12.18	42	0–66
Initial score	13.30	5.06	38	3–31	19.70	5.89	30	5–34
Final score	34.40	34.40	100	7–100	33.06	4.08	12	23–41

the ball bounce is 5 × 27 or 135. The means, standard deviations, and ranges of the initial and final scores may be found in Table 1.

Description of Methods of Measuring Improvement

Seven methods of measuring improvement are included in the statistical analysis of this study. Except where noted the names used for these methods are those assigned by the writer.

DIFFERENCE IN RAW SCORES

Perhaps the most common and certainly the most easily understood method of measuring improvement is that of obtaining the actual difference in raw scores between the initial and final administrations of a test. The formula for this method is simply:

Difference in Raw Score = Score of Final Test − Score of Initial Test

It is generally agreed that this method is limited because of the fact that individuals with low initial scores usually show more improvement than those with high initial scores. Logically it is harder for the person with the high initial score to improve because he is much nearer the physiological limit of performance than is the person with the low score. Various studies have indicated that there is little relationship or perhaps a low negative correlation between the initial status and improvement on the repeated performance of a test (1, 9).

DIFFERENCE IN T-SCORES

In this method of scoring, the raw scores for both the initial test and the final test are converted into T-Scores. Then the actual difference in T-Scores is obtained in the same manner as for the Difference in Raw Scores method. This method is essentially the same as the Standard Score Percent method described by Cureton (6, 7). In this latter method a standard score scale is constructed from the raw data. Since the standard score scale is 100 units long, each difference is divided by 100 to avoid different denominators in the percentages. Then the result is multiplied by 100 as for any percentage calculation. The formula for this method is as follows:

Percent Improvement

$$= \frac{\text{Difference Between the Means of the Standard Scores}}{100} \times 100$$

Inasmuch as 100 appears in both the numerator and the denominator in this formula, it is readily apparent that the result obtained is actually the difference between the standard scores and is thus comparable to the Difference in T-Scores method used in this study.

PERCENT GAIN OVER INITIAL TEST

The difference between the raw scores of the initial and final administrations of a test is divided by the score of the initial test to obtain the percent gain for this method. The formula is:

Percent Gain over Initial Test

$$= \frac{\text{Score of Final Test} - \text{Score of Initial Test}}{\text{Score of Initial Test}} \times 100$$

This method of scoring seems to be one of the most popular methods currently being used. An examination of 10 articles appearing in the *Research Quarterly* during the past 10 years revealed that this method has been used in 70% of the studies.

The Percent Gain over the Initial Test method seems to be inadequate for at least two reasons. First the percentages are not strictly comparable because different numerators and denominators are used in the computations. There is no common measuring rod to provide a base of reference. However, it is common practice to ignore this requirement in using such measures as a basis of comparison. For example, the Intelligence Quotient is computed in the same manner and is widely used in comparing an individual with the group or with another individual. A much more serious objection to this method is that the person with a high score on the initial test is seriously penalized in the computation. Everyone would agree that an increase from 20 to 22 feet in the running broad jump is more difficult than an increase from 8 to 10 feet. On the basis of the Difference in Raw

Score method both have a score of 2 feet. However, on the basis of the Percent Gain over Initial Test method the scores become 10 percent for the 20 to 22 feet increase and 25 percent for the 8 to 10 feet improvement.

PERCENT GAIN OF POSSIBLE GAIN IN RAW SCORES

An attempt is made in the Percent Gain of Possible Gain in Raw Scores method to give more credit to persons with higher initial scores by dividing the gain that a person makes on the final test over the initial test by what it is possible for him to gain over the initial test. Brace (4) has been an advocate of this method and has presented the following formula:

Percent Gain of Possible Gain in Raw Scores

$$= \frac{\text{Score of Final Test} - \text{Score of Initial Test}}{\text{Possible Score} - \text{Score of Initial Test}} \times 100$$

In those activities such as a target toss the possible score is a fixed measure; however, in those theoretically having infinity as the limit, the possible score must be arbitrarily established. This is usually done by using the best score that has been made in the activity. Using the world's record of 26 feet $8\frac{1}{4}$ inches as the possible score for the running broad jump, the scores for the performance of the previous illustration would become 30% for the 20 to 22 feet improvement and 11% for the 8 to 10 feet improvement.

This method has the same weakness as the Percent Gain over Initial Test Method in that the percentages are computed from varying points of departure. While this method does allow more credit for improvement by the individual with the higher initial score, it still does not seem to be entirely adequate. For example, two individuals make a score of 8 feet on an initial test on the running broad jump and on a final test make scores of 14 and 20 feet respectively. On the basis of the Difference in Raw Scores method the improvement scores would be 6 for the 8 to 14 feet performance and 12 for the 8 to 20 feet. It would be agreed that the latter improvement should be worth more than twice as much as the former since it becomes increasingly more difficult to improve as one reaches the possible score. Again using 26 feet $8\frac{1}{4}$ inches as the possible score, the scores computed by the Percent Gain of Possible Gain in Raw Scores method would be 32% for the 8 to 14 feet improvement and 64% for the 8 to 20 feet improvement. Thus it is seen that the latter performance is still only twice as good as the 8 to 14 feet improvement.

PERCENT GAIN OR POSSIBLE GAIN IN T-SCORES

This method was used by the writer (14) as an adaptation of the Percent Gain of Possible Gain in Raw Scores method used by Brace. The raw scores for the final and initial tests and for the possible score are converted to T-Scores and computations are made in the same manner as for the Percent Gain of Possible Gain in Raw Scores method.

INCREASED INCREMENT METHOD

In this method the measurement of improvement is based on the assumption that the performance curve is parabolic in nature and that the best fit equation for the performance curves of all types of events approaches $Y = KX^2$, where K is any constant (2). It is not within the scope of this paper to describe the computational procedures for this method. For an excellent treatment the reader is referred to Bovard, Cozens, and Hagman, *Tests and Measurements in Physical Education* (2). Increased increment scales of 100 points were constructed for each of the sets of data used in this study. The scores on both the initial and final tests were converted to increased increment scores from these scales and the improvement score was obtained by subtracting the increased increment score of the initial test from that of the final test.

Although there may be some doubt that the "best fit" formula will be applicable for all situations, this method seems to have merit as a method of measuring improvement. Perhaps the chief criticism is the laborsome task of computing increased increment scales.

STANDARD DEVIATION OR ABSOLUTE ZERO SCALE

In this method standard scores are assigned to each of the raw scores in the sample (10). Instead of using these standard scores as such or converting them to T-Scores, zero is arbitrarily assigned to the highest negative standard score representing the lowest raw score. Then all other standard scores are placed on the scale according to their distances from this lowest score. This provides an absolute zero as the point of origin of the scale and allows comparisons to be made on this scale. Each score of the initial test is then represented by an absolute zero scale score. Since these standard scores are based on the performance of the group on the test, each absolute zero score may be considered as an index of difficulty of the raw score it represents.

There seems to be some question as to the method of computing improvement from these absolute zero scale scores. A procedure has been used in obtaining a percent of gain by dividing the gain in raw scores from the initial to final test by the absolute zero scale score of the initial test (11). Inasmuch as the higher scores on the initial test have higher absolute zero scale scores, the criticisms outlined previously for the Percent Gain over Initial Test would hold for this method. In fact, a high degree of relationship has been found to exist between these two methods (11). It would seem more logical to multiply each gain in raw scores from the initial to final test by the absolute zero scale score value of the initial test. This procedure has been used with the data in this study.

This procedure would give an individual credit for improvement according to the difficulty of the starting point and enable an individual with a high score on the initial test to obtain more credit for the same improvement in raw score than a person with a low initial score. However, this

method seems to have the same limitation as the Percent Gain of Possible Gain in Raw Score method in that two individuals with the same score on the initial test would have their total improvement defined in terms of the same difficulty factor regardless of how far each advanced in the final test.

Findings and Interpretations

The means, standard deviations, coefficients of variation, and ranges for the seven methods and for the initial and final scores are presented in Table 1. The means and standard deviations are not directly comparable except between the initial and final scores. The T-ratio test reveals that there are very significant differences between the means of the initial and final scores in both the ball bounce and target toss tests.

TABLE 2

Ratios Between Means and Lowest and Highest Scores of the Difference in Raw Score Method and Those of the Other Six Methods[a]

	BALL BOUNCE			TARGET TOSS		
	Mean	Lowest score	Highest score	Mean	Lowest score	Highest score
Difference in T-scores	2.0	2	2.0	1.7	2	1.7
Percent gain over initial test	8.0	7	7.3	6.4	3	16.7
Percent gain of possible gain in raw scores	0.8	1	0.8	3.9	5	3.0
Percent gain of possible gain in T-scores	0.8	1	0.8	3.8	4	2.9
Increased increment	0.6	1	0.8	1.6	2	1.4
Absolute zero scale	2.6	2	3.2	2.2	3	2.4

[a] Ratios are obtained by dividing the mean of the Difference in Raw Scores method into each of the means of the other six methods and similarly for the lowest and highest scores.

Although the total range may be considered an unreliable measure of variability, it does indicate if unusually low or high scores are obtained by any one method of scoring. To determine this relationship among the methods, the ranges may be compared on the basis of the ratio among the means. For example, the mean of the Difference in T-Scores method for the ball bounce is approximately twice the mean of the Difference in Raw Scores method. This same relationship should hold between the lowest score of the Difference in Raw Scores method and the lowest score of the Difference in T-Scores method and between the highest scores of these two methods. An inspection of the highest and lowest scores for these two methods reveals that this relationship does exist. Thus it appears that neither of these two methods yields unusually low or high scores when compared with the other method. The means and the highest and lowest scores of each of the other six methods may likewise be compared with those of the Difference in Raw Scores method.

The ratios between the mean and the ratios between the highest and lowest scores of the Difference in Raw Scores method and those of the other six methods may be found in Table 2. Since zero was the lowest

score for all seven methods for the target toss test, the second lowest score was used for the purpose of these ratios. There seems to be little difference between the ratios for the means and the corresponding ratios for the highest and lowest scores except for the target toss test scored by the Percent Gain over Initial Text method. The ratio between the highest score for this method and the highest score for the Difference in Raw Scores method is over two and one-half times as large as the ratio between the means.

A more reliable comparison of the variability of the seven methods of scoring may be made on the basis of the coefficients of variation. An examination of these coefficients in Table 1 also reveals the most variation in the Percent Gain over the Initial Test method when used with the target toss test.

It is noted that on the basis of the measures of variability there is practically no difference between the Difference in Raw Scores and the Difference in T-Scores methods and between the Percent of Possible Gain in Raw Scores and the Percent of Possible Gain in T-Scores methods.

In Table 3 are presented the coefficients of correlation and the corresponding coefficients of alienation for various combinations of the seven methods of scoring improvement. A check on the reliability of the coefficients on the basis of the null hypothesis reveals that a coefficient of .257 is significant at the .01% level and that a coefficient of .197 is significant at the .05% level.

In general the coefficients among the methods of scoring seem to vary considerably between the two learning tests. The only coefficients of alienation for the ball bounce test that are significant at the .01% level are among those for the Percent Gain over Initial Test method and the Absolute Zero Scale method. For the target toss test all but two of the coefficients of alienation are significant at the .01% level.

It is difficult to determine why there seems to be more similarity among the methods of scoring when used with the ball bounce test than with the target toss test. Similar results would be expected with the more homogeneous group, but from an examination of the coefficients of variation for the two tests, it appears that the data for the target toss are more homogeneous than those for the ball bounce. It seems, however, that the large coefficients of variation for the ball bounce, especially for the final score, are due to a few unusually large scores. When the highest 25% and the lowest 25% of the scores are disregarded, the coefficients of variation for the ball bounce are 15 and 17 for the initial and final scores respectively as compared with 10 and 5 for the target toss. Although the coefficients of variation are still larger for the ball bounce, there is not nearly so much difference between the coefficients for the final score.

In determining the homogeneity of these data, consideration should be given to a comparison of the performance of the group on each test in relation to the possible performance. It will be recalled that the maximum possible score is 135 for the ball bounce and 45 for the target toss. A com-

parison of the means of the initial and final scores of each test with the respective maximum possible score reveals that the performance of the group is much nearer the lower end of the scale on the ball bounce than on the target toss.

The most consistent pattern of coefficients for both tests is found between the Difference in Raw Scores and the Difference in T-Scores methods

TABLE 3

Coefficients of Correlation and Coefficients of Alienation

TEST COMBINATIONS	BALL BOUNCE		TARGET TOSS	
	r	k	r	k
Difference in raw scores—Difference in T-scores	.999	.045	.978	.209
Difference in raw scores—Percent gain over initial test	.818	.575	.752	.659
Difference in raw scores—Percent gain of possible gain in raw scores	.996	.089	.786	.618
Difference in raw scores—Percent gain of possible gain in T-scores	.996	.089	.793	.609
Difference in raw scores—Increased increment	.995	.100	.902	.432
Difference in raw scores—absolute zero scale	.922	.387	.304	.953
Difference in T-scores—Percent gain over initial test	.815	.579	.759	.651
Difference in T-scores—Percent gain of possible gain in raw scores	.996	.089	.793	.609
Difference in T-scores—Percent gain of possible gain in T-scores	.996	.089	.802	.597
Percent gain over initial test—Percent gain of possible gain in raw scores	.773	.634	.314	.949
Percent gain over initial test—Percent gain of possible gain in T-scores	.768	.641	.341	.940
Percent gain over initial test—Increased increment	.760	.650	.534	.845
Percent gain over initial test—Absolute zero scale	.562	.827	.279	.960
Percent gain of possible gain in raw scores—Percent gain of possible gain in T-scores	.999	.045	.999	.045
Percent gain of possible gain in raw scores—Increased increment	.995	.100	.907	.421
Percent gain of possible gain in raw scores—Absolute zero scale	.941	.338	.714	.700
Increased increment—Absolute zero scale	.935	.355	.491	.871

and between the Percent Gain of Possible Gain in Raw Scores and the Percent Gain of Possible Gain in T-Scores methods. And with one exception the coefficients of correlation for these two combinations are the highest obtained. Close relationships for these methods of scoring were also indicated in the comparisons of variability previously discussed. It appears that nothing is gained in converting raw scores into standard scores when obtaining the difference between initial and final tests or when computing percent gain of possible gain. Inasmuch as the coefficients of correlation in each of the combinations approach unity, reference will be made in subsequent comparisons only to the methods utilizing raw scores.

There also appears to be a high degree of relationship between the Increased Increment method and the Difference in Raw Scores and the Percent Gain of Possible Gain in Raw Scores methods. The correlations between the Increased Increment method and each of the other two methods approach unity in the ball bounce and are above .90 in the target toss. However, it should be noted that the coefficients of alienation for the target toss are significant at the .01 % level.

The Percent Gain over Initial Test method seems to differ markedly from each of the other methods. The coefficients of alienation between this method and the other methods are all significant at the .01% level and almost half of the coefficients are over .80. If the other methods are at all valid it would seem that the Percent Gain over Initial Test method should not be used as a method of measuring improvement.

The Absolute Zero Scale method also appears to yield different results from several of the other methods. The coefficient of alienation for this method are all significant at the .01% level with about one-half the coefficients being above .80. It is noted that this method has the highest coefficients of correlation with the Percent Gain of Possible Gain in Raw Score and the highest coefficients of alienation with the Percent Gain over the Initial Test.

Summary of Findings and Interpretations

A comparison of seven different methods of measuring improvement from the initial to the final scores on a ball bounce and a target toss test indicates the following:

1. There seems to be little difference among the measures of variability for the seven methods of scoring except for the Percent Gain over Initial Test method when used with the target toss test.
2. As indicated by coefficients of correlation and coefficients of alienation, much closer relationships exist among the methods when used with the ball bounce test than when used with the target toss test.
3. There is practically no difference between the Difference in Raw Scores method and the Difference in T-Scores method and between the Percent Gain of Possible Gain in Raw Scores method and the Percent Gain of Possible Gain in T-Scores method when used with the data in this study.
4. In general the highest coefficients of alienation were obtained for the Percent Gain over Initial Test method. On the basis of logical reasoning this method appears to be the most inadequate of all the methods used in this study in measuring improvement.

REFERENCES

1. ANASTASI, ANNE. "Practice and Variability," *Psychological Monographs* **45**: 1-55; 1934.
2. BOVARD, JOHN F.; FREDERICK W. COZENS; AND E. PATRICIA HAGMAN. *Tests and Measurements in Physical Education*. Philadelphia: W. B. Saunders Company, 1949, p. 318-24.
3. BRACE, DAVID K. "Studies in Motor Learning of Gross Bodily Motor Skills." *Research Quarterly* **17**: 242-53; December 1946.
4. BRACE, DAVID K. "Studies in the Rate of Learning Gross Bodily Motor Skills." *Research Quarterly* **12**: 181-85; May 1941.

5. Cozens, Frederick W. "A Curve for Devising Scoring Tables in Physical Education." *Research Quarterly* **2:** 67-75; December 1931.
6. Cureton, Thomas K. "The Physiology of Fitness." *Scholastic Coach*, **13:** 14-20; March 1944.
7. Cureton, Thomas Kirk; Warren J. Huffman; Lyle Welser; Ramon W. Kireilis; and Darrell E. Latham. *Endurance of Young Man*. Monograph of the Society for Research in Child Development, Vol. 10, No. 1. Washington, D. C.: The Society for Research in Child Development, 1945.
8. Garrett, Henry E. *Statistics in Psychology and Education*. Third edition. New York: Longman's Green and Co., 1947.
9. Gates, Georgina Strickland. "Individual Differences as Affected by Practice." *Archives of Psychology* **8:** 1-74; August, 1922.
10. Greene, Edward B. *Measurements of Human Behavior*. New York: The Odyssey Press, 1941. p. 675-90.
11. Greene, Edward B. "Practice Effects on Various Types of Standard Tests" *American Journal of Psychology* **49:** 67-75; January 1937.
12. Guilford, J. P. *Fundamental Statistics in Psychology and Education*. Second edition. New York: McGraw-Hill Book Company, Inc., 1950.
13. McCloy, Charles Harold. *The Measurement of Athletic Power*. New York: A. S. Barnes and Company, 1932. p. 9-37.
14. McCraw, L. W. "A Factor Analysis of Motor Learning" *Research Quarterly* **20:** 316-35; October 1949.

The Influence of Soya Lecithin on Muscular Strength[1]

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MUSCULAR strength has played a significant role in man's survival and progress since the beginnings of human existence. From time immemorial man has continued to search for ways and means of increasing muscular strength in order that he might be better able to carry on life's activities at an optimal level of efficiency while, at the same time, expending a minimal amount of energy.

Recognizing the significant positive relationship existing between strength and motor performance (5, 7, 8, 17, 18), physical educators, coaches, and athletes have continually sought new methods of augmenting muscular strength over and above the increment attributable to the effects of training. The voluminous pertinent literature gives ample evidence of the prolific character of experimentation concerned with the work-producing attributes of concentrated nutriment and other special food substances (2, 4, 12, 14, 15, 20, 21, 23).

Prominent among those dietary adjuvants proposed as expedients in incrementing muscular strength is the commercial soybean concentrate, soya lecithin. Fundamental to claims for the efficacy of this food substance in increasing muscular strength is the assumption that its constituents, choline, phosphorus, and inositol, play a significant part in the functional efficiency of muscle and nerve tissue (3, 11, 19, 21, 22). Lending emphasis to the theoretical speculations regarding the ergogenic value potential of lecithin are the reports of pre-war investigations conducted in Germany by Atzler and Lehman (1) and Dennig (9). In each instance it was claimed that lecithin ingestion resulted in measurable improvement in muscular strength and performance.

Atzler and Lehman (1), in 1935, first reported the favorable effects of this phospholipid on muscle efficiency following observations made on five subjects who ingested soybean lecithin daily in amounts ranging from 22 to 83 grams. This dietary supplementation continued for several days while the subjects underwent tests of strength and endurance. The investigators concluded that, in the majority of cases, there was an increase in muscular performance for both static and dynamic work.

[1] An abstract of this report was read before the Research Section at the Fifty-Fifth Annual Convention of the American Association for Health, Physical Education, and Recreation, Dallas, Texas, April 21, 1950.

Dennig (9) also studied this problem experimentally and reported that lecithin ingestion resulted in improved muscle performance and physical efficiency.

In other quarters these favorable claims have been subjected to sharp question and largely discounted by protagonists of the negative view who take the position that (a) the German studies were inadequately controlled, (b) lecithin, as such, is probably not absorbed from the normal intestinal tract, and (c) if absorbed, its substrates are not capable of significantly altering the physical or chemical constancy of muscle and nerve tissue (4, 15, 16). Recent research by Capraro and Pasargiklian (6), at the University of Milan, tends to support these criticisms in that these investigators concluded that high parenteral dosages of lecithin bring about a decrease in the respiratory quotient while large amounts of lecithin taken orally do not result in such change.

On the other hand, Gortner (11) and Mitchell (19) hold that lecithins, or their components, are not only absorbed in the gut but that they play major physiologic roles in the human body.

Diametrically opposing data of this nature, stemming from biochemical theorizing and experimental conclusions, indicated rather clearly the need for further experimentation to determine the precise influence of lecithin on muscular strength. Consequently, in an attempt to shed more light on this problem, it was decided to repeat certain phases of the German studies and, at the same time, attempt to improve upon the conditions of these experiments by (a) utilizing a larger and more homogeneous group of subjects, (b) maintaining a more constant physical environment for testing, (c) extending the observational period, (d) offsetting the psychic factor by placebo feeding, (e) rotating groups to compensate for any innate chance group differences, and (f) subjecting the resultant data to more precise statistical analysis.

Purpose of the Study

The primary purpose of this investigation is to determine the effect of soya lecithin ingestion on the strength of the flexor muscles of the fingers, hand, and forearm.

Procedure

Thirty male subjects were arbitrarily segregated into three separate and equal groups on the basis of random selection. These volunteer subjects, all university students, ranged in age from 19 to 28 years and represented a reasonably homogeneous sampling with respect to motivation, health status, dietary, and general daily regimen.

The grip strength, as measured by the manuometer, was recorded triweekly for each subject for a period of eight weeks. Three measures of grip strength were recorded for each individual on each testing occasion. Weekly averages were determined for each subject from these nine raw scores, reported to the nearest pound, attained during a particular week.

The mean of each subject's scores for the first week established the base, or control, measure of his strength. Strength indices, representing weekly raw score means expressed as percent increment or decrement of the control week average, were recorded for every subject for each of the succeeding weeks of the experiment. Strength fluctuations of individuals ranged from -5.44 to $+29.36\%$ of the base measure.

Group I represented the control unit. Subjects in this group received neither lecithin nor placebo throughout the entire period of the study. Group II, the lecithin-placebo group, received a dietary supplementation of 30 grams of soya lecithin per man each day during the fifth and sixth weeks. Following this, during the seventh and eighth weeks, 30 grams of placebo, in the form of ordinary yellow corn meal, was substituted for the lecithin in the daily diet of each subject in this group.

Group III, the placebo-lecithin unit, served as the counterpart to Group II in that each subject in this group underwent daily feedings of 30 grams of placebo during the fifth and sixth weeks and 30 grams of soya lecithin during the seventh and eighth weeks.

It was felt that the rotation, or reversal, of Groups II and III, with respect to the experimental variable, would compensate for any possible innate or environmental disparity existing between the two groups and, consequently, add to the validity of the study. Furthermore, commercial yellow corn meal was employed as a placebo in order to provide for the possibility of the psychological factor influencing strength test performance during the lecithin feeding period.

Although, at present, the precise pattern of lecithin metabolism is largely conjectural, there are recent evidences that this substance is rapidly absorbed and utilized (11, 19, 24). Furthermore, since enzymatic balance is probably not significantly altered when the basic dietary remains unchanged, it was assumed that a feeding period of 14 days afforded adequate time for the attainment of whatever physiologic benefits might accrue.

From the individual strength indices weekly means were calculated for each of the three groups. Statistical comparisons, based upon the average percent increment of the control week mean score, could then be made between groups for each week of the investigation. In other words, valid and precise comparisons of group improvement in grip strength could be made.

Using methods appropriate for small sample data (13), critical ratios were computed in order to determine whether the observed differences between the weekly mean strength indices of the three groups were true, or significant, differences which might justifiably be ascribed to the influence of the experimental variable, or whether they could be attributed to chance factors.

The Findings

A comparison of the weekly mean strength indices of the three groups is graphically illustrated in Figure I. It will be recalled that the mean

percent increments for a group were derived from the 10 individual mean indices of the subjects within the group.

It may be observed from Figure I that the training curves of the three groups exhibit a considerable degree of parallelism. Further, it is significant that a marked leveling off period follows the fifth week of the investigation. This would seem to indicate that the increase in grip strength which might be ascribed to training as well as added skill in using the instrument had approached its optimum by the end of the fifth week of testing.

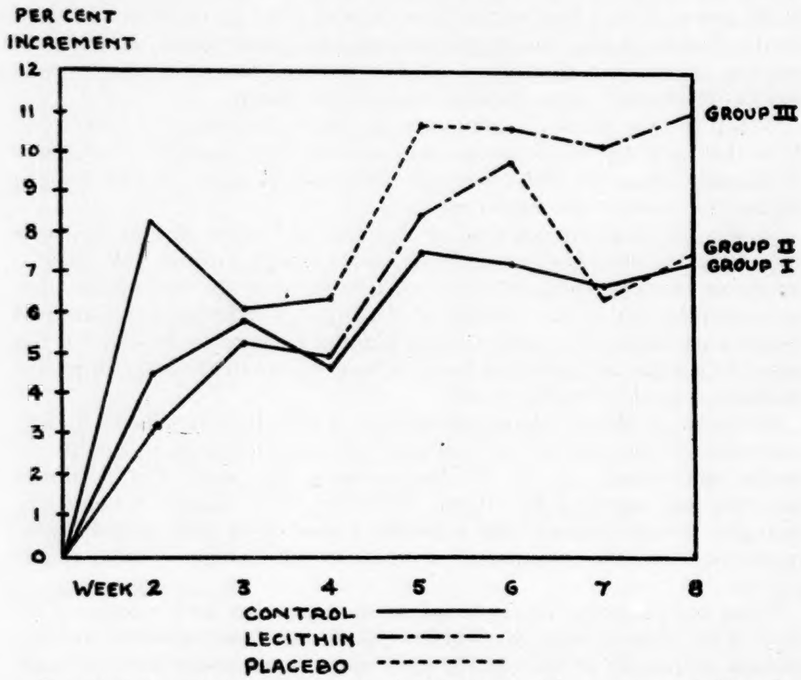

FIGURE I. Strength increment curves, based upon weekly group mean indices, for the three groups during the various phases of the study.

It is possible that the favorable conclusions of the continental studies (1, 9) were predicated upon the attribution of this early improvement in muscular performance to the effects of the experimental variable rather than to intrinsic myological phenomena.

Table 1 reports the weekly mean strength increment indices and the standard deviations for the three groups while inter-comparisons of the groups, in terms of the derived critical ratios, are shown in Table 2.

It is apparent that none of the obtained critical ratios approached a magnitude commensurate with either the 1% (t = 3.25) or the 5% (t = 2.26) levels of significance (10, 13). Accordingly, it may be stated with

confidence that no significant, or true, difference existed between the groups at any time during the investigation. Consequently, those relatively minor differences in strength indices evidenced during certain phases of the experiment may properly be attributed to sampling error rather than to any influence of soya lecithin or placebo. It is worthy of mention however, that the reported standard deviations, as cited in Table 1, are relatively large, reflecting a rather marked variability of the muscle performance of the individuals within the groups. It is a mathematical truism that

TABLE 1
Comparative weekly mean indices of strength increment and standard deviations for the groups studied

WEEKS	GROUP I		GROUP II		GROUP III	
	M	s	M	s	M	s
2	4.56	4.10	3.19	4.44	8.23	7.80
3	5.95	5.05	5.28	4.17	6.07	7.56
4	4.71	4.31	4.96	5.12	6.30	7.80
5	7.50	4.06	8.44*	4.45*	10.66†	7.42†
6	7.27	4.00	9.77*	7.21*	10.61†	9.10†
7	6.82	3.66	6.55†	6.24†	10.07*	9.29*
8	7.26	2.68	7.49†	6.65†	10.98*	10.13*

* Lecithin feeding.
† Placebo feeding.

TABLE 2
Comparison of strength indices between the various groups in terms of the critical ratio

WEEKS	GROUPS I-II	GROUPS I-III	GROUPS II-III
2	.68	1.24	1.69
3	.31	.04	.27
4	.11	.54	.43
5	.47	1.04	.77
6	.91	1.00	.22
7	.11	.98	.94
8	.10	1.04	.86

Group I served as the control group.
Group II received lecithin during the 5th and 6th weeks, placebo during the 7th and 8th weeks.
Group III received placebo during the 5th and 6th weeks, lecithin during the 7th and 8th weeks.

large standard deviations tend to make the differences between means appear less significant than they actually are. However, the differences between the means of these groups are so small as to preclude the possibility of the critical ratios approximating the 1% level of significance even if the dispersion of the indices within the groups were somewhat smaller.

Summary and Conclusions

Summary. Thirty male subjects were randomly segregated into three equivalent groups. The grip strength of each subject was measured tri-

weekly, by the manuometer, for a period of eight weeks. A subject's raw score average, in pounds, for the first week served as the base measure. Strength indices, obtained from weekly means expressed as percent of the base week, were recorded individually for the seven subsequent weeks.

Group I represented the control group. Group II ingested 30 grams of soya lecithin daily during the fifth and sixth weeks and 30 grams of placebo daily throughout the seventh and eighth weeks. Lecithin and placebo feeding periods were reversed for Group III which served as the counterpart to Group II. Thus, both the parallel-group and rotation-group techniques were used.

Inter-comparisons of the three groups were made for the various phases of the study on the basis of group mean strength indices and the derived critical ratios. None of the obtained critical ratios approached a magnitude commensurate with either the 1% or the 5% levels of confidence. Therefore, no true difference existed between the groups at any time during the investigation.

Conclusions. On the basis of a statistical analysis of the data afforded by this experiment, it would seem that the following conclusions are substantiative and justifiable as they pertain to young non-pathologic males:

1. The addition of 30 grams of soya lecithin to the normal daily diet does not significantly increase muscle strength nor modify the course of the training curve.
2. The withdrawal of soya lecithin supplement from the diet does not result in any material decrement in strength.
3. Observed increments in strength may be ascribed to improved skill in using the manuometer and to the effects of training on the muscle groups tested.

Acknowledgments

The writer is indebted to Associated Concentrates, Inc., of New York for its generous cooperation in providing their soya lecithin preparation "Asolectin" for use in this investigation.

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REFERENCES

1. Atzler, E. and Lehman, G. "Die Wirkung von Lecithin Auf Arbietsstoffwechsel Und Leistungsfähigkeit" *Arbeitsphysiologie*, **9:** 76, 1935.
2. Bing, F. C., "Guiding Principles for the Fortification of Foods" *Federation Proceedings* **1:** 336, 1942.
3. Bloor, W. B., *Biochemistry of the Fatty Acids and Their Compounds, the Lipids.* New York: Rheinhold Publishing Corporation, 1943.
4. Boje, O., "Doping: A Study of the Means Employed to Raise the Level of Performance in Sport," *Bulletin Health Organ., League of Nations*, **8:** 439, 1939.
5. Bovard, J. F.; Cozens, F. W.; and Hagman, E. P. *Tests and Measurements in Physical Education.* Philadelphia: W. B. Saunders Company, 1949.
6. Capraro, V., and Pasargiklian, M. "Influenza della Lecitina Alte Dosi sul Metabolismo Energetico e in Particolare su Quello Lipidico." *Arch., Fisiol.* **46:** 140, 1947.

7. COZENS, F. W., "Strength Tests as Measures of General Athletic Ability in College Men." *Research Quarterly*, **11:** 45, 1940.
8. CURETON, T. K. AND LARSON, L. A. "Strength as an Approach to Physical Fitness." *Research Quarterly, Supplement*, **12:** 396, 1941.
9. DENNIG, H. "Ueber Steigerung der Körperlichen Leistungsfähigkeit durch Eingriffe in den Saurebasenhaushalt," *Deutsche Medizin Wchnschr.*, **63:** 733, 1937.
10. FISHER, R. A. AND YATES, F. *Statistical Tables for Biological, Agricultural and Medical Research*. Edinburgh: Oliver and Boyd, Ltd., 1943.
11. GORTNER, R. A., *Outlines of Biochemistry*. New York: John Wiley and Sons, Inc., 1949.
12. HELLEBRANDT, F. A. AND KARPOVICH, P. V. "Fitness, Fatigue, and Recuperation," *War Medicine*, **1:** 745, 1941.
13. JOHNSON, P. O., *Statistical Methods in Research*. New York: Prentice-Hall, Inc., 1949.
14. KARPOVICH, P. V., "Ergogenic Aids in Work and Sports." *Research Quarterly, Supp.*, **12:** 432, 1941.
15. KEYS, A., "Physical Performance in Relation to Diet," *Federation Proceedings*, **2:** 164, 1943.
16. KEYS, A. Personal communication, March 27, 1950.
17. MACCURDY, H. L. *A Test for Measuring the Physical Capacity of Secondary School Boys*. Yonkers, N. Y.: the author, 1933.
18. MCCLOY, C. H., *Tests and Measurements in Health and Physical Education*. New York: F. S. Crofts and Company, 1946.
19. MITCHELL, P. H., *A Textbook of Biochemistry*. New York: McGraw-Hill Book Company, Inc., 1946.
20. MOREHOUSE, L. E. AND MILLER, A. T. JR. *Physiology of Exercise*. St. Louis: The C. V. Mosby Company, 1948.
21. SCHNEIDER, E. C. AND KARPOVICH, P. V. *Physiology of Muscular Activity*. Philadelphia: W. B. Saunders Company, 1948.
22. *Soya Lecithin, Its Use in Medicine*. New York: Associated Concentrates, Inc., 1946.
23. STEINHAUS, A. H., *Lectures on the Physiology of Exercise*. Chicago: the author, 1948.
24. ZILVERSMIT, D. B.; ENTENMAN, C., AND CHAIKOFF, I. L. "The Turnover Rates of Plasma Lecithin and Plasma Sphingomyelin as Measured by the Disappearance of Their Radio-active Phosphorus from the Circulation." *Journal of Biol. Chemistry*, **176:** 209, 1948.

A Badminton Wall Volley Test[1]

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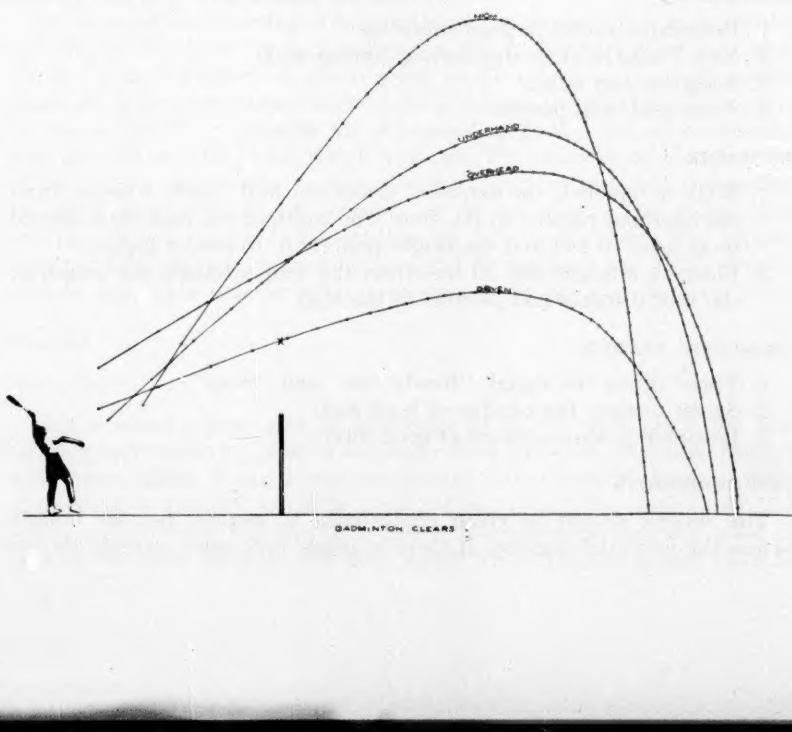
A SCIENTIFIC measurement to determine the playing ability of a badminton player is needed in the field of physical education. An attempt has been made to devise skill and achievement tests in badminton. In 1938, Campbell (2) devised a serving test, a forehand return test, a backhand return test, and a control test. James Scott (7) in 1941 made a study of the evaluation of badminton playing ability. His conclusions were drawn on the basis of evaluating and testing 16 players. Williams (9) made a study of skill tests in 1945. She attempted to set up tests for a forehand clear, backhand clear, low serve, high serve, back court drop shot, hairpin drop shot, and cross court drop shot. The backhand clear gave the highest reliability of .766 ± .054 and a validity of .549 ± .088. In 1945 Boldrick (1) devised tests for a low serve, smash, high serve, forehand lob, backhand lob, and forehand drop. The forehand and backhand lobs have an acceptable reliability and validity, but due to the fact that an impractical robot machine was used in order to propel the shuttlecock into the air, the lob tests cannot be used. Davis (3) carried on Boldrick's study in an attempt to improve the badminton skill tests. The Davis results were not as significant as the Boldrick results. French and Stalter (5) worked on tests for footwork, a service, clear, smash, and wrist volley. Edgren and Robinson (4) set up several ability tests in their book which were not validated. Scott and French (8) mention skill tests for a clear and a service in their book. The reliability and validity coefficients are significant with the results obtained from testing 29 major students. The volleying test which previously has given the highest reliability and validity for measuring total badminton playing ability was devised by Lockhart and McPherson (6).

[1] This material is taken from the thesis, "Construction of a Badminton Test" which was submitted in partial fulfilment of requirements for the degree of Master of Science in Physical Education in the graduate college of the University of Illinois, 1949. The author wishes to express her appreciation to T. K. Cureton, Jr., University of Illinois, for his valuable advice, help, and encouragement and to Aileene Lockhart and Jane Mott, University of Southern California and Laura Huelster, University of Illinois for their many helpful suggestions. The writer is extremely grateful to Richard I. Miller, University of Illinois, for his efficient help on the cinematographic study.

Construction of the Test

Rather than to attempt an almost impossible task of setting up a test for every stroke and factor involved in badminton, a study was made to determine which strokes contributed the most to total playing ability. At the Ninth Annual United States Amateur Badminton Championship Tournament which was held in Chicago in 1949, a careful study was made of the number of times services, drop shots, clears, smashes, drives, and half court drives were used during a badminton game. The strokes were counted by the use of hand counters which kept an accumulative record of the number of times each stroke was used. The finalists in both men's and women's singles events consistently used clears more often than any other stroke during all of their games. Drop shots came a close second in importance in regard to the amount of usage. The long service was used almost exclusively during singles play while in doubles play the short service was dominant. Smashes and half court drives were used more frequently in doubles than in singles. The stroke used depended upon the opponent and the situation. However in both singles and doubles, stress was placed upon the importance of an effective clear during a badminton game.

In order to determine the proper distance from the wall for the wall volley test, movies were taken of various types of clears, and a thorough study of clears was made by use of cinematography. A standard 35 mm motion picture camera was used. The camera was at right angles to the players and to the flight of the shuttlecock. The player hitting the shuttlecock was 87 feet away from the camera.



BADMINTON CLEARS

The diagram of Badminton Clears shows the actual path of the shuttlecock. The flight shows an interesting variation from the subjectively conceived paths which have been drawn by some experts. The picture shows a parabola which does not comply with the path of trajectory that is found in the flight of a ball or javelin. The difference lies in the construction and lightweight of the shuttlecock.

In the construction of the wall volley test, it was essential to know the minimum height that an ideal-driven clear would cross the net and still go over an average sized opponent's head when the racket was extended into the air. X in the diagram meets these qualifications. A multiplier was used to convert the drawing to actual size.

$$\frac{\text{Actual size}}{\text{Drawing size}} = \frac{72'' \text{ distance of dropped object}}{3.625'' \text{ distance represented on film}} = 19.84 \text{ multiplier}$$

By multiplying each distance on the drawing by 19.84, the actual size is obtained. The place where the shuttlecock crossed the net was $2\frac{1}{2}$ feet above the 5 foot net. This makes the wall height needed for the wall volley test 7 feet, 6 inches. As a badminton clear can go an indefinite height and still be in the court, a minimum height was the only line needed for the clear test. The player hitting the shuttlecock was 10 feet from the net. Therefore the person being tested stands behind a 10 foot restraining line. This volleying test puts the player in a position where he must clear the shuttlecock ~~in order~~ to do the test.

Administration of the Test

EQUIPMENT

1. Badminton racket in good condition
2. New *Timpé* outdoor shuttlecock (sponge-end)
3. Accurate stop-watch
4. Score cards and pencils

MARKINGS

1. Wall—a one inch line extended across the wall 7 feet, 6 inches from the floor and parallel to the floor. The width of the wall space should be at least 10 feet and the height preferably 15 feet or higher.
2. Floor—a straight line 10 feet from the wall extended the length of the wall distance and parallel to the wall.

ASSISTANTS NEEDED

1. Timer (gives the signal, "Ready, Go" and "Stop")
2. Scorer (counts the number of legal hits)
3. Recorder (makes a record of good hits)

TEST DIRECTIONS

The subject should be given opportunity to *practice* for one minute before the first trial is given. If there is ample wall space, several players

can practice at the same time and also can be tested at the same time as there is a 10 foot distance between players. A short *rest period* of at least 30 seconds should be allowed between trials. Practice should not be allowed between trials.

On the signal, "Ready, Go," the subject serves the shuttlecock in a legal manner against the wall from behind the 10 foot floor line. The serve puts the shuttlecock in a position to be rallied with a clear on each rebound. If the serve hits on or above the 7 foot, 6 inch wall line, that hit counts as one point and each following rebound hit made on or above the 7 foot, 6 inch wall line when the subject is behind the 10 foot floor line counts as one point. The hit is not counted if any part of a foot goes over the 10 foot restraining line. (Due to the fact that a subject encounters difficulty when trying to look at the line on the floor along with watching the shuttlecock, it is suggested that a chalk line three inches back from the 10 foot line be added, and the subject told to stay behind that line if possible. This allows the foot to slide as much as three inches without penalizing the person being tested. Also the scorer should say "Back" whenever the subject consistently goes over the line). The hit is not counted if the shuttlecock goes below the 7 foot, 6 inch wall line. However either in the case of the foot going over the 10 foot line or the shuttlecock hitting below the 7 foot, 6 inch line, the subject is permitted to keep the shuttlecock in play. The shuttlecock may be stopped at any time and restarted with a legal service from behind the 10 foot floor line. If the shuttlecock is missed and falls to the floor, the subject picks up the same shuttlecock as quickly as possible, gets behind the 10 foot floor line, and puts the shuttlecock into play with a legal service.

An accumulative number of hits made within 30 seconds is given to the recorder by the scorer for each individual. When the timer gives the signal "Stop," a total number of hits is given to the recorder. Three 30-second trials are given. Any stroke may be used to keep the shuttlecock in play. A "carried bird" or a double hit is counted as good if the hit eventually goes on or above the 7 foot, 6 inch wall line. The subject may step in front of the 10 foot line in order to keep the shuttlecock in play, but hits failing to follow the specifications given above do not count. The sponge end shuttlecock will bounce if the shuttlecock falls to the floor. The subject does not have to pick up the shuttlecock if he can keep the shuttlecock in play in any other manner. The score consists of the sum of three trials.

Results

RELIABILITY

One hundred college girls of all ranges of ability were given the test one day and within a period of no longer than one week, the same players were tested again. Practice was not allowed either between trials or from one period of checking until the next testing period. The same timer and scorer administered the test both times. The identical wall was used as well as the same marking and stop watch. Only Timpé outdoor shuttle-

cocks in good condition (all the feathers and no splits in the sponge) were used. By correlating the first test score (sum of three trials) against the second test score (sum of three trials), the reliability of the wall volley test was .94 ± .008.

VALIDITY

Due to the fact that the wall volleying test was set up scientifically by the use of movie analysis, and the player being tested can only clear the shuttlecock in order to do the test, the validity as far as a clear is concerned is established. In order to determine how much a clear contributed to total badminton playing ability, 20 players were given the wall volley test and a continuous round robin tournament was completed between the same 20 players. All together 380 games of singles were played. The results give quite an accurate indication of the ability of the players. The scores on the wall volley test were correlated with the results of the round robin tournament. In checking validity in relation to total playing ability, the wall volley test revealed a coefficient of .83 ± .047.

NORMS

Norms should be set up according to the situation as wall surfacings and other conditions will vary.

From scores made by 100 University of Illinois girls, the range was from 9 to 113, the mean 41.69, and the sigma 19.6. A smooth cement-plaster wall surfacing was used.

From scores made by 115 boys at the University of Southern California, the range was from 20 to 118, the mean 76.33, and the sigma 21.7. The test was given against a smooth brick wall surfacing.

CONCLUSIONS

1. The wall volley test is a reliable and valid measure of either total playing ability in badminton or specifically a measure of a clear in badminton. The reliability of .94 ± .008 and validity of .83 ± .047 are significant coefficients.
2. The practicality of the test is shown in the fact that the test is non-time consuming, easy to administer, takes only a small amount of space, and does not involve much expense.
3. The test is of value from the standpoint of usage for grading purposes, a practice device, diagnostic purposes, measuring achievement, interest and variety in teaching, and for a classification test.
4. The results of the cinematographic study indicate that a thorough understanding of each specific item is an important aid in test construction. Better results seem to occur when tests are constructed logically and scientifically.

REFERENCES

1. Boldrick, Evelyn L. *The Measurement of Fundamental Skills in Badminton.* Master's thesis, Wellesley, Mass.: Wellesley College, 1945. (Unpublished)

2. Campbell, Virginia M. *Development of Achievement Tests in Badminton.* Master's thesis. Austin, Texas: The University of Texas, August 1938. (Unpublished)
3. Davis, Barbara. *The Relationship of Certain Skill Tests to Playing Ability in Badminton.* Master's thesis. Wellesley, Mass.: Wellesley College, 1946. (Unpublished)
4. Edgren, Harry D. and Robinson, Gilmer G. *Group Instruction in Tennis and Badminton.* New York: A. S. Barnes and Company, 1939.
5. French, Esther and Stalter, Evelyn. "Study of Skill Tests in Badminton for College Women." *Research Quarterly,* **20:** 257–72; October 1949.
6. Lockhart, Aileene and McPherson, Frances A. "The Development of a Test of Badminton Playing Ability," *Research Quarterly,* **20:** 402–405; December 1949.
7. Scott, James H. *A Study in the Evaluation of Playing Ability in the Game of Badminton.* Master's thesis. Columbus, Ohio: The Ohio State University, 1941. (Unpublished)
8. Scott, M. Gladys and French, Esther. *Better Teaching Through Testing.* New York: A. S. Barnes and Company, 1945.
9. Williams, Glenna Rae. *A Study of Badminton Skill Tests.* Master's thesis. Denton, Texas: Texas State College for Women, 1945 (Unpublished)

An Investigation of the Validity of Using the Results of a Doubles Tournament as a Measure of Handball Ability

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FREQUENTLY grading practices in physical education are the subject of much discussion and, at times, the object of considerable criticism. Many of the problems which exist in this area are not readily solved. The grading plan, for example, may vary with the curriculum, school regulations, availability of equipment, teaching level, educational philosophy of the teacher, and a multitude of other factors. Performance, however, is generally considered an important component of any grading plan; in fact, it is quite common for the entire grade to be based upon performance criteria.

Limitations of time, facilities, and equipment often present serious hurdles to the conscientious instructor who wishes to objectively measure performance in sports. To overcome these difficulties is one of the important justifications for the construction of various sports' ability tests.

The results of a singles round robin are sometimes employed in the measurement of achievement in such sports as handball, badminton, and tennis. However, it is generally considered advisable to utilize the faculty and limited facilities of colleges most efficiently by enrolling four students per court in each section of these courses. But, as demonstrated in a previous paper (2), in the majority of situations it is impractical to conduct a doubles tournament which would correspond to a round robin singles tournament. In such a doubles tournament, each player is paired off with every other player and, with each of these partners, he plays every possible combination of the remaining players.

However, at least one alternative is available; namely, to conduct a doubles tournament in which the partners are selected at random and no student plays more than once with the same partner. It is recognized, of course, that the score each player receives is in part due to the ability of his partner. This probably is not important if a complete round robin tournament is played with a sufficiently large number of players, since every student has every other student as a partner sometime or another during the tournament. Even if a complete round robin tournament were not conducted, if a reasonable number of games are played and the partners are selected in a random manner, it appears logical that the results of such a doubles tournament could be legitimately used as an index of playing

ability. The purpose of this study is to investigate the validity of this practice when handball is the sport concerned.

Procedure

The result of a round robin singles tournament is commonly considered a valid measure of handball ability if there is a relatively large number of players involved. In this study it was not feasible to conduct a complete round robin singles tournament, but a portion of such a tournament was conducted with the players selected at random, no two players opposing each other more than once. Since there are seven handball courts at Michigan State College, 28 students are normally enrolled in each section. Two sections of handball were used in this experiment. Before the quarter[1] was completed, two students in each section dropped the course, leaving 26 subjects available in each section for whom data could be tabulated. Inasmuch as it did not seem advisable to begin tournament play until after the students had received considerable instruction and practice, the available time permitted each subject to play, at most, 11 games of the singles tournament. Due to absences, some of the subjects played as few as eight games.

Concurrently with the singles tournament, a portion of a round robin doubles tournament was conducted in which the partners were selected at random, no two players forming a team more than once. As in the singles tournament, a complete round robin tournament would require each student to play 25 games. As before, limitations in time resulted in each student playing at least eight, but not more than 11 doubles games.

Four different methods of computing a handball ability index were investigated. They are as follows: (a) percentage of games won; (b) average score per game; (c) total score made in all games minus total score of opponents; (d) average score per game minus average score of opponents. These measures computed from the singles tournament were correlated with the same measures computed from the doubles tournament for the same subjects. This was done for each section separately, and also after pooling the results. It was anticipated that the scores of the subjects who played fewer games would tend to reduce the correlations of these measures when the results of the singles and doubles tournaments were compared. Therefore, the comparisons were repeated with the pooled results, but with the scores of those subjects who played only eight games eliminated.

Results

All of the handball indices derived from the singles and doubles tournaments were plotted as frequency polygons. Although the number of cases was too small to permit the application of statistical techniques for testing the assumption of normality, all distributions did appear to be at least unimodal when plotted.

[1] Michigan State College operates under the so-called quarter plan, each quarter consisting of approximately 12 weeks.

The coefficients resulting from the intercorrelation of the singles and doubles tournament results are presented in Table 1. The Pearson product-moment method using raw scores was employed to compute these coefficients. All of the variables correlated were plotted. There appeared to be no significant deviation from rectilinearity in any of these plots. Before pooling the results of both sections, the means and variances of the distributions were compared for the two sections. This was done for all of the handball ability indices. In no case was the difference in means or variances significant at the 5 % level.

Discussion of Results

The correlation coefficients representing the relationships between the results of the singles and doubles tournaments ranged from 0.641 through 0.882. The lowest coefficients resulted when "percent of games won" was used as the measure of handball ability (0.641–0.773). This is understandable, since the index is very crude. The winner of a game receives just as much credit for winning by one point as for winning by 10 points. Furthermore, since relatively few games were played, the scale itself is crude, there being a maximum of only 12 percentage points when the entire 11 games are played.

The results for the three remaining indices are approximately the same. In this sample, the average score per game produced slightly higher coefficients, but these differences were not significant at the 5 % level. There is one advantage, however, in using the difference scores. There will not be the inclination, on the part of some students when they are sure of a win, to allow their opponents, especially good friends, to score more points. This practice would decrease their own difference scores, but would not affect their average score per game or percentage of games won.

An inspection of the table of results also discloses that the inclusion of subjects who played only eight games decreased the correlation coefficients. It appears reasonable that if all subjects had played 11 games, the coefficients would have been considerably larger. In fact, although the reliability of the measuring instruments is not being investigated, the Spearman-Brown prophecy formula appears applicable. However, some subjects played as few as eight games and some as many as 11; hence, this formula would only give a very rough estimate of how many games would be required to achieve any desired coefficient.

The most meaningful interpretation of the coefficients reported here probably is in terms of the displacement associated with it or, in other words, the differences in positions of the scores in one series from those for the same subjects in the other series. If we may assume the scores are normally distributed, a correlation coefficient of 0.855, for example, would result in the following displacement in terms of the standard deviation: 64.6% of cases will fall within the same division, one standard deviation wide, in the two series; 34.8% of the cases will fall in divisions one standard deviation apart. In other words, there is less than one chance in 100

that a subject's relative position in the doubles tournament will be more than one standard deviation away from his relative position in the singles tournament when the correlation coefficient is 0.855.

It is interesting to note that the highest multiple correlation coefficient secured by Cornish (1) in his five-item handball test was 0.694, using the difference score as the criterion of ability. However, his test requires less time to administer than even an 11-game doubles tournament and is of

TABLE 1

Correlation of scores in the doubles and singles handball tournaments

HANDBALL ABILITY INDEX	CORRELATION COEFFICIENT	N	95% CONFIDENCE LIMITS FOR ρ*
Percent of games won			
1st section	0.641	26	0.336, 0.824
2nd section	0.762	26	0.531, 0.888
Both sections combined	0.699	52	0.525, 0.816
9- 10- and 11-game subjects	0.773	36	0.569, 0.878
Average score per game			
1st section	0.823	26	0.639, 0.918
2nd section	0.831	26	0.653, 0.922
Both sections combined	0.837	52	0.731, 0.903
9- 10- and 11-game subjects	0.882	36	0.780, 0.939
Total difference score (Total score minus total score of opponents)			
1st section	0.750	26	0.510, 0.882
2nd section	0.840	26	0.670, 0.926
Both sections combined	0.812	52	0.693, 0.889
9- 10- and 11-game subjects	0.855	36	0.733, 0.924
Average difference score (Average score minus average score of opponents)			
1st section	0.745	26	0.502, 0.879
2nd section	0.839	26	0.669, 0.926
Both sections combined	0.808	52	0.686, 0.885
9- 10- and 11-game subjects	0.855	36	0.733, 0.924

* Correlation coefficients were converted to "z" scores to determine limits of ρ.

value in diagnosing weaknesses in play. Furthermore, some instructors are reluctant to use the results of tournaments for grading purposes.

Very likely, results similar to these would be secured if the experiment were repeated with sections of a badminton or tennis course. Furthermore, when the results of a sufficient number of subjects are available, norms may be constructed and employed in grading.

Summary and Conclusions

The principal purpose of this study was to determine whether or not the results of a doubles tournament in which the partners were selected

at random could be used as a valid measure of handball ability. Two sections of a service course in handball, each comprising 26 college students, were used in this experiment. A singles tournament was conducted in which the opponents were selected at random, no two players opposing each other more than once. Each of the 52 subjects played from 8 to 11 such matches. These same subjects played from 8 to 11 games in a doubles tournament. The results of the two tournaments were correlated using the following as the subjects' handball ability indices: percentage of games won; the average score per game; total score minus total score of opponents; and average score minus average score of opponents.

Coefficients of correlation ranging from 0.641 to 0.840 were secured, with the "percentage of games won" producing the lowest coefficients. Disregarding the scores of the subjects who played only eight matches raised the coefficients in every case. These coefficients ranged from 0.773 to 0.882.

From the results of this investigation, the following conclusions appear justified.

1. A doubles handball tournament with partners selected at random, no two players forming a team more than once, ranks the players according to ability in approximately the same order as a singles tournament, providing the number of games is sufficiently large, and either the average score or difference between player's score and that of his opponents is used.

2. The results of a doubles tournament of this nature is a valid measure of handball ability and is practical for use in a grading plan where a measure of performance is desired. Probably the best measures are the total difference or average difference scores.

3. Increasing the number of games played in the doubles tournament increases the validity for this method of appraising handball ability. Each subject should play at least 11 or 12 matches.

REFERENCES

1. Cornish, Clayton. "A Study of Measurement of Ability in Handball." *Research Quarterly* **20:** 215-222; May 1949.
2. Montoye, Henry J. "Note on Round Robin Tournaments" *Physical Educator* **6:** 19-20; December 1949.

Increase in Speed of Movement by Motivation and by Transfer of Motivated Improvement

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REACTION time has been a popular field of research in physical education (4). Experimentation on this subject has a long history —interest in speed of reaction is in fact as old as experimental psychology itself. Yet the study of possible mechanisms for speeding up reaction time has been largely neglected, except for some experiments on set, optimum time of the fore-period and the role of stimulus character and intensity on the speed of response (5). A notable exception is Johanson's study (1) of three individuals, in which he observed that motivational factors were very important—simply telling the subject how fast he had reacted increased his simple finger reaction about 7 %. Administering a mild electric shock when a reaction was slow was much more effective, increasing the speed somewhat more than twice that amount.

It is the purpose of the present investigation to confirm these results, and to discover if they can be generalized to include more complicated "speed of movement" responses. In addition, it is proposed to examine the possibility of transfer effects, since practical application of the phenomena will depend to a considerable extent on whether or not speeding up one type of response will result in an increased speed in another and somewhat different type of movement that is not directly motivated.

Apparatus and Method

The principal features of the apparatus are shown in Figure I. A ball A is hung on a string, the lower end of which is attached to the baseboard while the upper end terminates in a plastic strip B that is held frictionally by the flat springs C. The subject's finger tips rest on the baseboard just in front of the restraining strip D. When a signal light at F flashes on, he grabs the ball. This causes B to drop out from between the springs C, opening the chronograph circuit and the electric shock circuit by means of contacts at C.

The operating key is a three-position silent operating telephone switch, connected so that a red preparatory signal lights up at F when the key is moved from *off* to position 2, while moving it to position 3 starts the chronograph, turns on a stimulus light (or rings a gong for an auditory

stimulus) and starts the electronic delayed-action shock device. The stimulus light is kept burning at a dull red continuously to minimize any time-lag in the stimulus. A switch permits it to be replaced by an electric gong, which is also made quick-acting by energizing it through the discharge of an electric condenser. Another switch disconnects the shock circuit as desired, or replaces it with a bright light or a noise-producing device. (In the present experiment, only the electric shock was used as a motivator).

There is of course nothing original about the use of a thyratron electronic tube to produce a controllable delayed action. Such a device is not as precise in its action as a mechanically operated delay, but has the advantage of continuously and easily adjusted range of delay that can be controlled by a variable resistor with a calibrated dial indicator. A relay

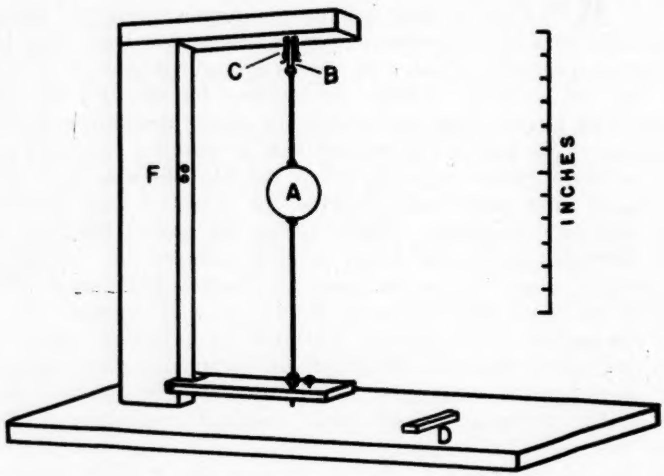

FIGURE I. Speed of movement apparatus

in the output circuit can be used to control any desired electrical, mechanical or acoustic device.

Shock is applied to subject by a pair of three-eighths by one-half-inch metal electrodes held one-fourth-inch apart by mounting them on a strip of bakelite. An elastic strap keeps the electrodes in contact with the skin of the upper arm about midway on the lateral aspect. More or less arbitrarily, it was decided to shock the arm used in the motor responses, balancing the possibility of an interference effect against directness of connection between movement and shock. To insure safety in the shock circuit, the ordinary electric current is not used directly. Instead, it is passed through an inverted amplifier output transformer worked from a low voltage supply. The output voltage of the transformer is about 250 v. A one-fourth-watt neon glow lamp is included in the circuit in order to insure that a high resistance is in series with the subject so that variations

in his own resistance will have little effect, and at the same time provide a visual indication of when he receives a shock. At maximum intensity, the device forces about 4 milliamperes of 60-cycle current through the subject's skin. With electrodes of the size employed, this is sufficient to produce a definite but mild electric shock sensation, localized at the electrodes. It should perhaps be mentioned that there is no danger whatsoever in using electric shock in this manner, although there are of course other ways of using shock that are hazardous.

The chronograph is of a quiet type, further silenced by mounting it in an airtight box. Dial divisions are in units of .01 seconds. Repeated calibrations established the standard deviation of the instrumental error at .009 seconds. It may be noted that while an instrument with an accuracy of only about .01 seconds is not ordinarily considered good enough for reaction time work, it is as a matter of fact entirely adequate for most purposes. Since the standard deviation of individual single reactions is more than three times larger than this in the case of a simple finger-press movement and considerably greater for speed-of-movement responses, the instrument cannot be responsible for more than a small fraction of the total error (4).

In order to provide for measuring other types of responses in addition to the ball snatch, a hinged treadle can replace the ball. Pressing down this treadle one-eighth-inch pulls the vertical string sufficiently to drop out the plastic strip and actuate the contacts. The treadle is used to measure finger-press reaction time as well as more complicated movements as, for example, lifting the hand from the restraining strip and moving it forward in order to press down the treadle target.

The functioning of the apparatus and the role of the subject [S] may be summarized as follows: After hearing the standard instructions, S sits on a stool with eyes on the signal lights. The hand to be tested rests on the apparatus table, finger tips on the restraining strip (or with index finger on the treadle if measuring simple finger-press reaction). The experimenter [E] is behind him to avoid nonintended cues. The warning light comes on, and 2 seconds later (or 1, 3, or 4, in accordance with a prepared chance-order sequence) E presses the stimulus key, which turns on the stimulus and simultaneously starts the chronograph. S reacts, which causes the plastic strip to drop out of the upper contacts, thus stopping the timer and disconnecting the "incentive" or electric shock circuit. If he has reacted with sufficient speed, he avoids the shock entirely; if he is slow, he receives the shock until his movement has been completed. The electronic delay dial has been pre-set to his preceding average or median speed of movement, and is readjusted from time to time as S increases his speed. E attempts to adjust the delay circuit so that S receives shock for the slowest 50 % of his movements.

Ss were male university students, mostly physical education majors. All served on a voluntary basis. The writer wishes to express his appreciation to these men for donating their time, and to Sanford Munro and Kenneth Tucker for technical assistance in securing the data.

Experiments on Motivation

Effect of electrode strap. In order to determine if the wearing of the electrode strap had any effect on the speed of response, 6 Ss (not otherwise tested) made 30 treadle press responses with the strap on and 30 with it off. Trials were grouped in 10's, alternating between the two situations. With the strap on, the average time per response was .282 seconds, and with it off .284 seconds. The difference, less than 1 % was clearly not significant.

Simple reaction time. Twenty Ss were used in this experiment. The visual stimulus (light flash) was used. Ten of the men were shocked on their slow finger-press reactions and 10 served as a no-shock control group. The groups were fairly well matched in their initial reaction time, the time scores being .182 seconds for the experimental group compared with .181 seconds for the controls when the first 5 reactions were averaged.

The experimental group speeded up 9.4% (first 5 reactions compared with last 5), the average gain being significant at the P = .02 level of confidence when analyzed by the conventional small-sample t ratio method. The difference remains significant at above the .05 level of probability when the average of more of the early trials and more of the late trials are compared, although the average difference of course decreases. Improvement continued during the first 25 trials, but was clearly absent during the last 25. The control group did not change significantly during the experiment—the probability of any apparent practice effect being due to chance was P = .20 or greater.

Treadle-press movement. New Ss—10 experimentals and 10 controls—made 50 responses per subject on the first day's testing. No shock was used. There was no evidence of any learning. The average time per response for the experimental group was .334 seconds; for the control group .340 seconds. During the second day's testing, the control group made 50 responses averaging .336 seconds, another 50 averaging .341 seconds, and a final 40 averaging .339 seconds. Obviously, there was no practice effect in this group.

On the second day, the Ss of the experimental group were informed that they would be shocked for their slow responses later on during the test, but that the first 50 trials would be without shock. Their speed of movement immediately improved, reaching a 7.7% increase in the first 15 trials, a highly significant change since the t test gives P = .0001. They retained this gain, but without further improvement, during the next 35 trials. The electric shock motivation was then started, resulting in an evenly progressive increase in speed until they had improved 11.5% after 35 trials (the improvement again being highly significant, with P = .002). There was no further improvement after this point, although they continued with 15 more trials, and after a rest, with an additional 40. The total improvement over the original control period was therefore 19.2%, compared with an increase of 0.3% in the control group for the same number of trials.

Ball-snatch movement. Eight experimental Ss and 8 controls made 50 ball-snatch responses per subject. There was a noticeable learning effect. From an initial time score of .364 seconds for the first 5 responses, the total group decreased 2.7%, leveling off after 20 trials. The control group decreased 4.3% from an initial score of .378 seconds, leveling off after 15 trials.

After the completion of the 50 trials, the Ss in the experimental group were given 35 trials with shock. Previous to this time, they had not been told about this part of the experiment, and after the test they were requested to refrain from divulging it. Using the last 25 trials of the preceding nonmotivated reactions as a reference point (.352 seconds average), progressive improvement in speed of response was observed during the next 20 or 25 trials. The average time score for the last 15 reactions was .272 seconds, representing a speed increase of 17.1%. The mean difference in individual scores was significant at a confidence level of $P = .008$. Comparable scores for the control group showed a speed increase of 3.1%, a difference that was not statistically significant.

Briefly summarizing these experiments, it is clear that the results of Johanson on the motivating influence of electric shock in speeding up reaction time have been confirmed, although the average amount of the effect has been observed to be less than he reported for his three subjects. A considerably larger increase in speed has been found for two types of movements that are more complex than the simple finger reaction. Even the knowledge that shock is to be used later in the experiment has a significant effect in increasing the speed of movement.

Experiments on Transfer

The general pattern of the transfer experiments has been to test the speed of movement of S with some 50 or 75 responses, then interpose a period of practice with a simpler movement, and finally retest the speed of the original more complicated movement. In the experimental group, Ss are motivated by electric shock while practicing the simpler movement, whereas the control group Ss receive no shock. This design makes it possible to separate out any possible transfer effect caused by practicing the simpler movement from the transferred general speed-up due to the motivation factor. The more complex movement is not directly motivated at any time —the facilitating effect is transferred from the interposed simpler movement.

Transfer from finger press. Since this was intended only as a preliminary experiment, only 5 experimental Ss and 5 controls were used. All Ss were given 50 trials on the ball-snatch coordination. At this point there were interposed 50 finger-press reaction time trials, motivated by electric shock in the case of the experimental group, but unmotivated in the control group. Immediately afterward there were 50 ball-snatch responses.

As may be seen in Table 1, both groups improved during the first half of the initial practice period. The control group leveled off at about .323

seconds. Perhaps as a result of transfer from practicing the finger-press movement, or perhaps just as a chance fluctuation in the data, this group averaged about 3% faster in the second ball-snatch practice period. The gain was not statistically significant. The experimental group leveled off at about .338 seconds in the initial practice period. During the second ball-snatch practice the average was .318 seconds. This transfer effect from the motivated finger press, a matter of 6% improvement, was statistically significant at the confidence level of $P = .005$.

Transfer from treadle press. It was decided to concentrate the main experimental effort on transfer from the treadle press rather than transfer from the finger press. The treadle press, as related to the ball snatch, has the common element of an initial raising of the hand followed by a forward movement. The ball snatch has the additional elements of upward diagonal movement and a complex grasping movement in contrast to a simple downward press. It was anticipated that it would be possible to show factually that, while similar, the two coordinations were by no means identical. This proved to be the case. A correlational analysis of the responses of 76 individuals who made 50 ball snatches followed by 20 unmotivated treadle presses shows a relation of $r = .91$ between the first and second groups of 20 ball snatches, whereas the rs between 20 ball snatches and the 20 treadle presses are .72 and .71. Thus there is 83% variance in common between the ball snatches compared with 51% variance in common between the ball snatch and the treadle press; i.e. there is a 32% differential that can be ascribed to difference in the nature of the two coordinations.

TABLE 1

Transfer from motivated finger press to ball snatch

(Mean time of ball snatch movement in seconds for each 10 trials. N = 5.)

	INITIAL PRACTICE					PRACTICE AFTER FINGER PRESS				
PRACTICE PERIOD	1	2	3	4	5	1	2	3	4	5
Control group	.330	.323	.327	.317	.325	.312	.311	.316	.320	.309
Experimental group	.342	.344	.336	.336	.341	.314	.321	.322	.315	.319

To study the transfer of motivated improvement in the treadle press to the more complex ball-snatch response, 20 new Ss, 10 experimentals and 10 controls, were given an initial ball-snatch practice period of 80 trials. This was followed by 50 unmotivated trials on the treadle-press response. A few days later, the Ss were retested with 90 treadle-press trials per S, followed immediately by 80 trials with the ball snatch. The only difference in treatment between the experimental group and the control was that the former was shocked for the slow responses on the second day treadle-press responses, while the latter received no shock. The results are shown in Figure II. In the initial ball-snatch practice period the controls leveled off at .363 seconds, and averaged .354 seconds in the retest period. The difference

was not statistically significant. The experimental group leveled off at .360 seconds in the initial practice period and averaged .316 seconds in the retest, a gain of 12% which was highly significant at a confidence level of P = .0002.

Interstimulus transfer of motivated improvement. To permit further generalization from the results, a new set of 10 experimentals and 10 controls was tested as in the preceding experiment, with certain modifications. The number of ball-snatch responses was cut down to 50 in the initial test and the number of treadle-press responses was reduced to 10 without motivation, followed by 60 with shock motivation for the experimental group and 60 without motivation for the controls. Immediately afterwards, both groups were retested with 50 ball snatches without direct motivation. This alteration permitted the complete experiment to be performed at a single

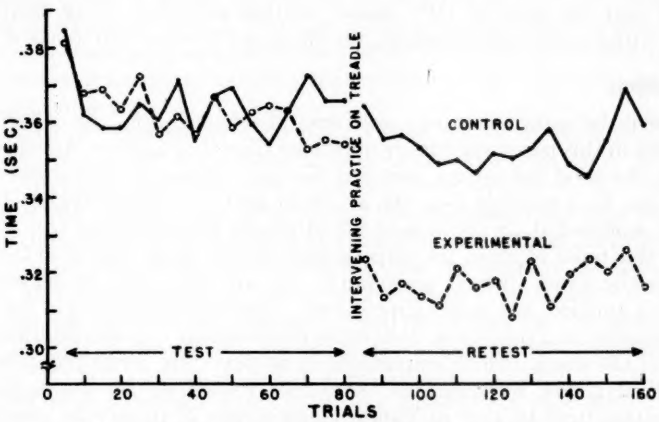

FIGURE II. Practice curves for ball-snatch movement

one hour sitting. A further and very important alteration was made—the stimulus for the treadle press was changed to the electric gong, while the ball-snatch stimulus remained visual. With this change, the transferred effect involved crossing from (a) a relatively simple response to a motivated auditory stimulus, to (b) a nonmotivated more complex motor response to a visual stimulus.

The findings are very similar to those of the preceding experiment. During the initial ball-snatch test—during the first 10 trials particularly—there is some improvement in both groups due to practicing the coordination. However, the curve soon levels off. The retest scores of the control showed a 4% improvement that might have been due to transfer from practice on the treadle response, but the change was not significant since t is only 1.7. The experimental group improved about twice as much as the control. Initially its time scores averaged .336 seconds, leveled off at

.327 after 10 trials, and averaged .303 for the 50 ball-snatch retest trials. The improvement is highly significant, since P = .0005. Even with a 4% allowance subtracted under the assumption that the control group gain is a real effect, the improvement in the experimental group is statistically acceptable, since P = .035.

It may be noted that the experimental group, while very closely equated to the control group in the initial ball-snatch tests, was considerably slower than the controls in the first 10 (unshocked) treadle-press responses. This finding strengthens the argument presented earlier to the effect that the two coordinations, while superficially quite similar, are in fact by no means identical.

Permanence of the transfer effect. The twenty Ss of the interstimulus transfer experiment were retested with 50 ball-snatch responses after an elapsed time of two weeks. The experimental group averaged 0.7% slower and the control 3.9% faster, neither difference being significant. Thus, without any reinforcement, the effect is stable for two weeks at least.

Discussion

As may be expected in any new area of investigation, the experiments reported in this paper raise more questions than they answer. Among these, one of the most intriguing concerns the psychological mechanism of the speed-up. It is possible that the action is that of a Thorndykian Law of Effect, modified along the lines of the McGeoch interpretation (3). According to this point of view, the achievement of a response that is so fast that the electric shock (which presumably has an annoyance or punishment value) is avoided, is a satisfying outcome, whereas the receiving of the shock is unpleasant and punishing. It is quite possible that it is the informational value of the shock (which emphasizes in no uncertain terms just how slow a particular slow response has been) that results in the speed-up. This explanation may be cast in Thorndykian terms, or it may be considered more operationally as a question of S needing to know when he has achieved a satisfactory performance, if he is to learn how to perform satisfactorily. There are of course a number of psychological ramifications of this concept. It may even be that the shock merely functions in keeping the subject attentive to his task; possibly it is wrong to attempt an explanation in terms of any learning theory.

The nature of the transfer mechanism is not elucidated in the present study. Presumably it is in part a matter of common elements (2); the smaller transfer from motivated finger press to unmotivated ball snatch compared with treadle press to ball snatch is suggestive in this respect. But there is definitely a distinction between this and the more conventional transfer experiments. Here, it is not the result of learning one skill that is transferred to the learning of another skill—rather it is the motivation effect that is transferred. In fact, the experiments that are reported here do not show any statistically acceptable evidence that practicing one of the skills improved performance in the other skill, since the control groups did not

show significant gains in the retests. With larger groups, these gains might indeed prove significant, but they are in all cases small compared with the motivational transfer.

The particular coordinations studied were deliberately chosen to minimize the influence of learning. Nevertheless, it is possible that there was a large element of "latent learning," which some students of learning consider as simply improved *performance* elicited by increased motivation (the learning having already taken place), whereas others—McGeoch for example—contend that the *improvement* constitutes learning (3). If one accepts the latter point of view, the results may be considered as a type of "transfer of training"; if one holds to the distinction between *learning* and *performance* (as the present writer does), it is motivation rather than learning that is transferred. In the latter case, speed of movement should be affected relatively more than simple reaction time, where the time-consuming factor is largely neural rather than muscular. Long, time consuming movements should be more influenced than short movements. The present results are not inconsistent with this explanation, but further investigation is necessary before a theoretical interpretation can be made with any confidence.

The present experiments have not touched on the optimum intensity of the shock, or on the optimum number of shocked responses. Actually, these two questions reduce to one. For very brief stimuli, there is an integration of the time and intensity factors; the magnitude of a stimulus is in general the product of its duration and intensity. Increasing the proportion of shocked responses will necessarily increase the duration of the shock, thereby increasing both its frequency and magnitude. It is therefore rather important to discover the influence of these factors on the amount of speed-up, both to secure the maximum effect and to determine how accurately this factor needs to be controlled in future research.

As McGeoch points out, there have been a number of experiments showing that signalling the achievement of a "correct" response is more effective than similarly signalling an "incorrect" response. These findings suggest that it would be better to signal how fast are the "fast" responses, rather than how slow are the "slow" responses. While this is technically rather difficult to do with an automatic apparatus, it is not impossible.

Summary and Conclusions

An apparatus was designed for the purpose of measuring simple reaction time (finger press), speed of a coordinated movement (snatching a ball) and speed of a less complicated movement (treadle press). An adjustable electronic delay circuit provided for administering a mild electric shock for slow responses. Visual stimuli were used.

The simple reaction time of 10 Ss shocked in their slow responses improved 9.4%, while a control group of 10 remained constant. The treadle-press speed of 10 Ss improved 11.5% when motivated by shock, compared

with no change in a control group. In the ball-snatch coordination, the speed of 8 Ss improved 17.1% when shock was used, compared with a 3.1% percent improvement in the controls.

In another series of experiments, a control group practiced a coordinated movement, shifted to practice with a simpler movement, and was then retested on the original coordination. A comparable experimental group did the same, except that electric shock was administered for slow responses during the practice on the simpler intermediate movement. This experimental design permitted the measurement of transfer effects. The first experiment of this series, using the ball snatch for the coordinated movement and the finger press for the simple movement, showed a 6% gain due to transfer in the motivated group of 5 Ss compared with a 3% gain in the controls. Using the treadle press as the simpler movement, the 10 Ss of a new motivated group exhibited a transfer effect of 12%, compared with no significant effect in the controls. In a similar experiment in which the intermediate treadle-press practice utilized an auditory stimulus, involving an interstimulus transfer of the motivated improvement, 10 Ss showed a transfer of 7.4% while the controls failed to exhibit any significant transfer.

In all cases, the motivation produced a statistically significant speed-up, and the motivated improvement in a relatively simple response showed statistically acceptable evidence of transfer to a more complicated coordination. There was no significant transfer demonstrable from the unmotivated practice with the simpler movement. While superficially similar, the ball snatch and treadle press are not identical coordinations since there is a 32% ~~differential~~ variance compared with 51% common variance. Depending on the theoretical position adopted, the results may be considered as due to a type of transfer of training, or they may be considered as due to a transfer of the motivation effect. The latter appears to be the more reasonable.

Regardless of the explanation adopted, motivation due to administering electric shock (during the period of a reaction or movement that is slower than an individual's own average reaction) has a significant facilitating influence in speeding up the reaction or movement. This speed-up is transferable, at least within limits, from one type of reaction or movement to another and from one stimulus mode to another.

REFERENCES

1. Johanson, A. M. "The Influence of Incentive and Punishment upon Reaction Time." *Archives of Psychology*. **8:** No. 54; 1922.
2. Lindeburg, F. A. "A Study of the Degree of Transfer Between Quickening Exercises and Other Coordinated Movements." *Research Quarterly* **20:** 180–195; 1949.
3. McGeoch, J. A. *The Psychology of Human Learning*. New York: Longmans, Green, 1945. p. 583, 597.
4. Scott, M. G., editor. *Research Methods Applied to Health, Physical Education and Recreation*. Washington: AAHPER, 1949. p. 299, 465.
5. Woodworth, R. S. *Experimental Psychology*. New York: Holt, 1938.

The Retention of the Increase in Speed of Movement Transferred from a Motivated Simpler Response*

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JOHANSON in 1922 was apparently the first investigator to show that electric shock when administered on slow reaction speeded up the simple finger lift reaction time (3). Recent experiments done by Henry (2) confirm this earlier finding, and extend it to increasing the speed of more complicated movements. These later investigations include the study of transfer effects. The results reveal that a motivated simple response transfers its increase in speed (due to motivation) to a more complex response. The practical application of these results is contingent upon how long this transferred increase in speed of movement is retained. It is proposed to investigate this retention problem in the present study by retesting subjects at various later time intervals.

Method and Procedure

Responses. The speed-of-movement responses were measured by a chronoscope which had an accuracy somewhat greater than .01 second.

There were two speed of movement responses. One was the grabbing of a ball, hereafter to be called the "ball snatch", or "BS". This movement consisted of the subject making an 11 inch diagonal movement forward and upward to grab a tennis ball that was suspended by a string between a fixed and a removable point of attachment.

The other speed of movement response consisted of the subject's hitting a hinged treadle, hereafter to be referred to as the "treadle press", or "T". This movement was simpler than the BS, involving just a forward movement of the hand about seven inches to hit the end of the treadle and disconnect the circuit.

Prior to each response, (using his preferred hand), the subject kept his hand behind a restraining stick and concentrated upon a preparatory and a stimulus light which were placed at eye level about 24 inches in front of his head. The preparatory light preceded the stimulus light in foreperiods of one, two, three, or four seconds. Foreperiod patterns were prepared

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beforehand in random order to prevent anyone from memorizing a preparatory set pattern.

The experimenter first turned on the preparatory light, then the stimulus light; when this latter light lit up, the subject made the appropriate response which pulled out the removable end of the ball or treadle assembly and disconnected the chronoscope circuit. The speed of movement response, as was recorded by the chronoscope, was the time required for the subject to disconnect the circuit after the stimulus light lit up. This includes both his reaction time and his speed of movement. A more detailed description of the apparatus is given in a recent paper by Henry (2).

The electric shock used for motivation was mild. The subject wore an elastic strap above the elbow. This strap held two small metal electrodes in contact with the skin of the arm he used to make the reactions. They were electrically wired to a delay switch incorporated in the apparatus so that the subject automatically got a shock in his arm whenever his reaction exceeded a certain predetermined time which was based on his average for the first 20 treadle presses. When the removable end of the ball or treadle press assembly was disconnected, this also disconnected the shock circuit.

Testing procedure. The initial speed of movement test consisted of 170 measurements given in the following sequence:

50 ball snatches
20 treadle presses
50 treadle presses with shock motivation
50 ball snatches

Retests of 50 ball snatches only were given later after various time intervals.

Subjects. Sixty University of California male students ranging in ages from 18 to 42 were the subjects. Ten were tested each week for six weeks in the above initial procedure. Then the group which was tested the sixth week was retested the seventh week; the group which was tested the fifth week was given the retest the eighth week, etc., so that retest time intervals of one, three, five, seven, nine, and 11 weeks resulted.

There was also a control group of eight subjects. They were tested in the same procedure except that they were not motivated during their last 50 treadle presses. In addition to this control group, the control group data in the earlier study cited above was available. This latter group was made up of 10 subjects.

Controls. Each subject was given specific identical test instructions.

Each subject was tested in the afternoon. This was felt necessary for control since Elbel (1) found that reaction time varies depending on the time of day.

No subjects were tested immediately after strenuous exercise, after eating, or when they felt fatigued. In the opinion of the writer, such controls insured that everyone was in about the same physical condition when taking the initial test and the retest.

Experimental Results and Discussion

Table 1 summarizes the results of this experiment. "BS_0" represents the initial 50 ball snatches, "MT" refers to the series of responses on the treadle press with shock motivation, while "BS_1" is the second group of 50 ball snatches and "BS_2" the 50 ball snatches given at the later time interval. The averages are in seconds, each figure representing the average of 500 responses.

Table 2 compares the results from three perspectives. $BS_0 - BS_1$ is the gain due to the motivated treadle press MT; $BS_0 - BS_2$ is the amount of retention of the transferred increase in speed of movement for each group, and $BS_2 - BS_1$ is the decline from the speed attained as a result of the shock motivation.

TABLE 1

Average speed of movement in seconds for each group in the initial test and retest

	INTERVAL (WEEKS)					
	1	3	5	7	9	11
Ball (BS_0)	.315	.332	.318	.309	.308	.299
Treadle (MT)	.251	.266	.265	.257	.259	.243
Ball (BS_1)	.293	.294	.300	.287	.293	.293
Ball retest (BS_2)	.289	.298	.299	.301	.321	.304

TABLE 2

Comparison of averages in Table 1 for all groups

	TEST-RETEST INTERVAL					
	1	3	5	7	9	11
Transfer (BS_0-BS_1)	.022	0.38	.018	.022	.015	.016
Retention (BS_0-BS_2)	.026	.034	.019	.008	−.013	−.005
Decline (BS_2-BS_1)	−.004	.004	−.001	.014	.028	.021
"t" ratio of decline	0.92	1.78	0.37	3.59	5.96	7.59

Transfer. The "t" ratio from comparing the means of BS_0 and BS_1 for all groups is 9.63, a difference that is highly significant. The difference could be due to practice on the treadle, to the motivation, or to both. In order to determine the amount of improvement due to motivation, the improvement due to practice effect made by the control group can be subtracted from the total improvement made by the motivated groups. The "t" ratio drops to 6.90 when this is done.

When the control group available from the earlier study is combined with the controls of the present study to give a larger and more dependable control group, the "t" ratio becomes 6.00 when the practice effect is subtracted. These results indicate that the major part of the improvement is due to the electric shock motivation.

It can be seen that the third week group is irregular in BS_0, hence also in $BS_0 - BS_1$, but there is no reason for this to influence the conclusions of the study.

Retention: This comparison reveals the amount of increased speed each group retained after several weeks of elapsed time, as related to the speed on their initial test. A difference of zero would indicate that no retention existed; the speed on the initial test would be the same as the speed after the specified retest time interval. A negative figure means that that group was slower on the retest than they had been on their first test, as is the case with the ninth and eleventh week groups.

Decline. These figures compare the speed of each group on its retest to its speed on the test in which the increase in speed of movement had been transferred from the motivated simpler response. It can be seen that the groups which were retested at intervals of one, three, and five weeks reacted at about the same speed on each test, indicating that they did not decline in speed significantly after those periods of time. The "t" ratios for these groups are not statistically significant when comparing the means of their BS_2 and BS_1.

TABLE 3

Relation between foreperiod and speed of reaction

Foreperiod	*Mean*
One second interval	.309
Two second interval	.289
Three second interval	.287
Four second interval	.289

The groups which were retested at seven, nine, and 11 weeks show a statistically significant loss in the improvement that they had made by being motivated by shock, the "t" ratios being 3.59, 5.96, and 7.59 respectively.

On the basis of these experimental results, it can be seen that there is a significant loss in speed of movement after a five week time interval when comparing the means of the first retest and the second retest.

Subsidiary Investigation

With such an abundance of material it was felt worthwhile to analyze the foreperiod data compiled in this study. Many previous studies have been made on the relation of foreperiod to reaction time; for example, a typical one was done in 1916 by Woodrow (5) who found the optimal foreperiod to be two to four seconds. There have only been a few studies of the optimum foreperiod for speed of movement. One example is the experiment of Tuttle, Morehouse, and Armbruster (4), who found an optimum foreperiod of two seconds for a swimming sprint.

In the present experiment random selection was made of 4000 speed-of-movement responses of 50 subjects, 1000 of them being taken for each foreperiod. The results show that the reactions of the subjects to the one

second foreperiod is decidedly slower than the reactions to the other three, which are all about the same. This short foreperiod apparently catches the subject before he is set, resulting in a momentary hesitation. Although the three second foreperiod gives a movement that is slightly faster than the other two, the indication is that the maximum range for readiness is probably two to four seconds. This substantiates the earlier study by Woodrow on reaction time.

Summary and Conclusions

A speed-of-movement test was given 60 male university students. Their speed in grabbing a ball was tested, then they pressed a treadle, receiving an electric shock when their response was slow. This motivation speeded up their reaction, and the increased speed was transferred to a second ball-snatch test. In order to find out whether or not the transferred speed up of response due to motivation was retained for an appreciable period of time, another ball snatch retest was given later. It was found, using a control group which did not receive shock motivation, that the major part of the improvement was due to the electric shock motivation.

Six groups were tested, each group consisting of 10 subjects. Each subject made 170 responses in the specified sequence. Later, these groups were given a second retest of 50 responses at time intervals of one, three, five, seven, nine, and 11 weeks. The average of the last 50 responses of the original retest, in which the subjects had speeded up due to the transferred electric shock motivation, was compared with the average of the 50 responses of the second retest at the later time interval.

On the basis of the obtained results, it is concluded that a period of seven weeks is required for the increase in speed transferred from a motivated simpler response to significantly retrogress toward the initial speed of movement. Furthermore, varying the foreperiods between two, three, and four seconds does not influence the speed of response, although a one second foreperiod results in slower responses.

REFERENCES

1. Elbel, E. R. "A Study of Response Time Before and After Strenuous Exercise." *Research Quarterly* **10**: 35–50, 1939.
2. Henry, F. M. "Increase in Speed of Movement by Motivation and by Transfer of Motivated Improvement." *Research Quarterly*, **22**: No. 2, 1951.
3. Johanson, A. M. "The Influence of Incentive and Punishment Upon Reaction Time." *Archives of Psychology* **8**: No. 54, 1922.
4. Tuttle, W. W., Morehouse, L. E., and Armbruster, D. "Two Studies in Swimming Starts." *Research Quarterly*, **10**: 89–98, 1939.
5. Woodrow, H. "Outline as a Condition of Attention." *Journal of Experimental Psychology* **1**: 23–37, 1916.

Basketball Shooting[1]

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BASKETBALL shooting is a difficult skill and yet it is a challenging one. Students seem to think so. To them, the thrill of looping a ball cleanly through the hoop is worth hours of practice; and the opportunity and responsibility of helping them to develop shooting skill is very well worth careful analysis and thought.

It is often true however, that the understanding of the instructor does not permit her to do more for students than put them in situations in which they can practice shooting and suggest to them methods of throwing the ball. In consequence, their learning has been trial and error to a greater degree than is necessary. An analysis of the flight of a basketball and of the probability of a goal being scored by a particular shot would enable students to understand specifically what they are trying to do. Such analysis would make possible an evaluation of each trial and would, therefore, decrease the trial and error element of learning.

Any ball in flight has speed and direction. Any specific speed combined with a specific direction results in an arc of flight (Figure I).

In any given situation, as for example in the case of a free shot, both the skilful player and the skilful instructor form a concept of the arc of flight of a successful shot. In teaching, the instructor attempts to convey to the learner a concept of the correct arc of flight. One factor in defining the arc is the position of the high point of flight. Instead of attempting to describe the position of the high point by such expressions as "a little higher," "a little lower," or "a little closer to the basket" the instructor might set up a learning situation that places the high point exactly.

Once the position of the high point of a specific shot has been determined[2] a light bar or taut rope could be suspended at a height of one and a half inches above the high point. Small strips of material, preferably of a material that rattles when hit, could hang down from the bar a distance of $1\frac{1}{2}$ inches, so that the free ends mark the high point of flight.

[1] Submitted by National Section on Women's Athletics.

[2] $$H = \frac{V_0^2 \sin^2 \theta}{2g} - f$$

where H—vertical height of high point
V_0—initial velocity
θ—vertical angle of projection
g—acceleration of gravity—32.172 ft./per/sec.
f—height of release—5 ft.

Obviously, the horizontal distance of the high point from the point of release as well as its height above the ground must be described. For this purpose a line (Line 1) could be marked on the floor parallel to the suspended bar. In addition to the bar and line complete description of the arc demands another parallel line (Line 2) to mark the end of the flight.

A student standing behind Line 1 and releasing a ball directly over it can check the arc of flight by watching for contact with the suspended strips and with Line 2. Here is a situation in which the concentration is on the arc of flight.

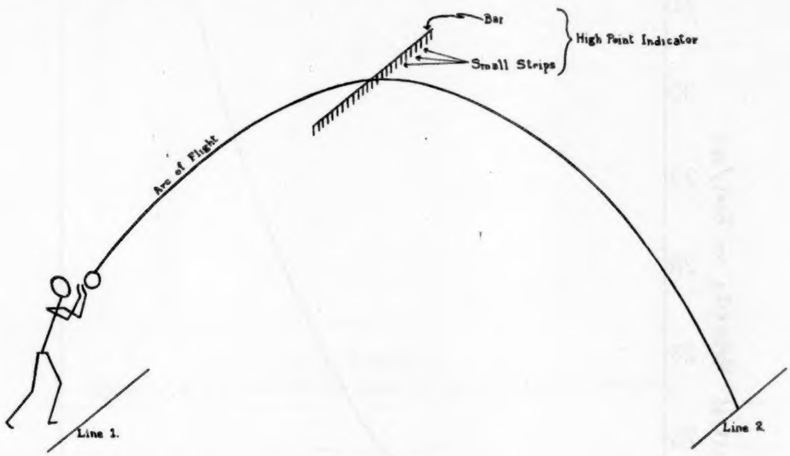

FIGURE I

Illustrating the suggested learning situation and showing the arc of flight of a correct shot. The ball is released over Line 1, it touches the ends of the small strips and lands on Line 2.

In addition to developing a visual picture of the arc of flight, the student must develop a kinesthetic memory of its execution. She should be urged, therefore, to concentrate on the "feel" of each shot correctly performed, so that she can learn to repeat the shot, not only in the same situation, but also in the situation in which the basket is present.

Once the student becomes proficient in attaining the desired arc set by the above situation, further demands upon precision of movement could be made by substituting a point for Line 2. The point marker should rise above the floor, but should not be more than an inch or two off the ground. It should be from ½ to 2 inches in diameter (the smaller the better). The point permits a finer evaluation of the distance reached by the ball, and a finer evaluation of its deviation to right or left. The point might be in the form of a small suction cup or other device placed on Line 2.

The bar and line arrangement provides a learning situation that can accommodate a considerable number of students at one time.

Performing the practiced shot at the basket is the next progression. The student should now be able to visualize the correct arc of the ball in flight in the absence of the high point marker and should be able to execute the shot with the basket present. Should she at any time begin to forget the

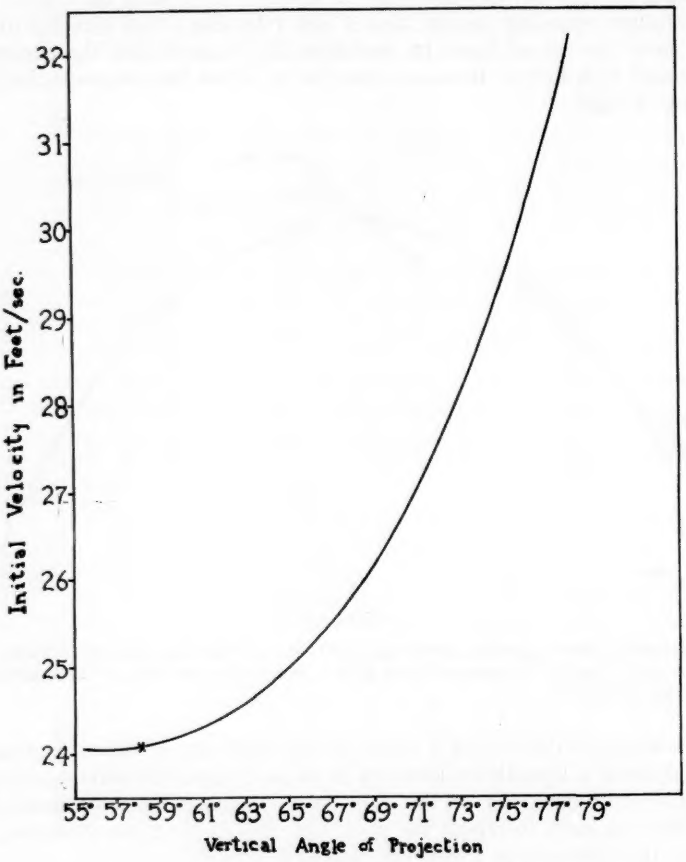

FIGURE II

Showing initial velocity and vertical angle of projection combinations for the 12 foot shot which make the ball go through the center of the bracket.

feel of the correct shot, or should the basket distract her attention, she can go back to the bar to refresh her memory.

A practice situation such as the bar and line arrangement means that the instructor has chosen one specific arc as the most desirable. Since at any given distance from the basket a number of arcs of flight would result

in a successful shot, an explanation of the basis for a choice of arc will be presented.

If a 12-foot distance is taken as an illustration (12 feet being the horizontal distance between the point of release and the center of the basket) a tabulation of possible vertical angles of projection (direction, in the vertical plane) and corresponding initial velocity (speed) can be made.[3]

TABLE 1

Initial velocity and vertical angle of projection combinations for the 12 foot shot which make the ball go through the center of the basket

VERTICAL ANGLE OF PROJECTION	INITIAL VELOCITY FT. PER SEC.
55° 29′	24.072
57°	24.069
58°	24.099
59°	24.150
60°	24.227
61°	24.330
62°	24.458
64°	24.796
66°	25.255
68°	25.850
70°	26.607
74°	28.764
78°	32.271

TABLE 2

Effects of a +1° error in the angles of projection of 12 foot shots

1	2	3	4
Vertical angle of projection	Initial velocity (ft. per sec.)	Distance of ball center from basket center Z	Margin by which ball clears front rim Cl
		inches	*inches*
57° + 1°	24.069	0.528	0.391
58° + 1°	24.099	0.925	0.390
59° + 1°	24.150	1.343	0.343
60° + 1°	24.227	1.736	0.282
61° + 1°	24.330	2.100	0.212
62° + 1°	24.458	2.474	0.107

If the release is 5 feet above the floor, the minimum angle of projection is 55° 29′ above the horizontal. It is obvious that 89° 59′ is the theoretical maximum since any angle greater than this would not permit the ball to reach the basket. Therefore, the angle of projection of possible shots range between these 2 extremes. The initial velocities which, when combined with given angles will make the ball go through the center of the basket are graphed in Figure II for angles between 55° and 78°.

[3] Note: Since the desirable angle in the horizontal plane is obviously 0°, this phase of the projection will not be discussed.

The graph shows that between 56° and 59° little change in velocity is needed with a change in angle. Above 59° with each increase in angle, the velocity must increase at a greater rate. Table 1 is also included to show the actual velocities required to put the ball through the center of the basket, and, again it can be seen that the change in initial velocity for angles below 59° are relatively small. It would appear therefore that a slight error in the angle of projection at angles below 59° should not affect the arc of flight greatly.

A mathematical approximation of just how serious such an error would be has been made and the results are shown in Tables 2 and 3. (An illustration of the effect of the error is given in Figure III.) As would be expected, the tables show that the seriousness of a 1° error increases with the angle of projection. As the angle increases, the same 1° error (either increase or decrease) causes the ball to deviate farther and farther from the center of the basket (column 3).

TABLE 3

Effects of a −1° error in the angles of projection of 12 foot shots

1	2	3	4
Vertical angle of projection	Initial velocity (ft. per sec.)	Distance of ball center from basket center Z	Margin by which ball clears front rim Cl
		inches	*inches*
57° − 1°	24.069	−0.085*	0.199
58° − 1°	24.099	−0.553	0.780
59° − 1°	24.150	−0.963	1.340

*** A negative number means that the center of the ball is beyond the center of the basket.**

From this point of view, therefore, lower angles of projection allow greater margins for error.

However, at the lower angles the ball passes very close to the front portion of the rim. A mathematical approximation of the margin by which the ball clears this portion of the rim is shown in column 4 of the tables. It can be seen that when the 1° error causes an *increase* in the angle of projection (Table 2) the margin of clearance is greatest at the lowest angle, but that when the error causes a *decrease* in the angle of projection (Table 3) the margin of clearance is least at the lowest angle. Since, in this latter case, the margin is only 0.199 inches at 57° − 1° but is 0.780 inches at 58° − 1° and 1.340 inches at 59° − 1° it would seem advisable to choose either the 58° or the 59° arc for the 12 foot shot. In the former case, the margin is 0.391 inches at 57° + 1°, 0.390 inches at 58° + 1° and 0.343 inches at 59° + 1° indicating that here 58° is almost as good as 57° and that 59° is not quite as good as either 58° or 57°.

The writer, therefore, believes that the 58° projection (in combination with the velocity necessary to put the ball through the center of the basket) probably allows the shooter the greatest margin for error.

Similar, though as yet incomplete, deductions have resulted in the choice of a 54° projection for a 16 foot shot.

The measurements required in setting up a learning situation for both these shots follow (Table 4).

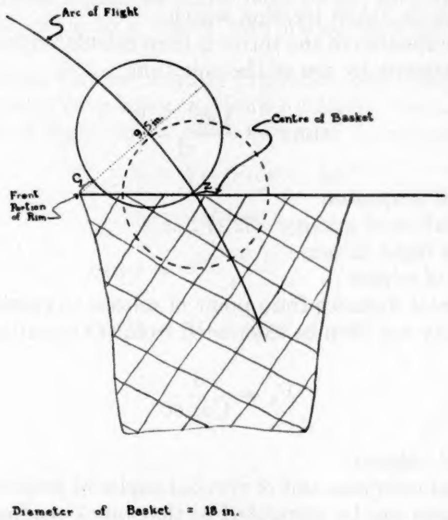

FIGURE III

Diagram of the effect of a 1° error in the vertical angle of projection showing the margin by which the ball clears the front portion of the rim C[1] and the distance between the center of the ball and the center of the basket at basket level Z.

TABLE 4

Measurements for two learning situations

SHOT	VERTICAL ANGLE OF PROJECTION	INITIAL VELOCITY (ft. per sec.)	VERTICAL HEIGHT OF LOW ENDS OF STRIPS HANGING FROM BAR Height of center of ball + Radius of ball = Total height	HORIZONTAL DISTANCE FROM HIGH POINT TO LINE 1	HORIZONTAL DISTANCE FROM HIGH POINT TO LINE 2
12 foot	58°	24.099	11 ft. 5.88 in. + 4.75 in. = 11 ft. 10.63 in.	8 ft. 1.32 in.	10 ft. 9.48 in.
16 foot	54°	26.461	12 ft. 1.44 in. + 4.75 in. = 12 ft. 6.19 in.	10 ft. 4.2 in.	13 ft. 6 in.

It is quite possible that a beginning student would be unable to throw a basketball at a velocity great enough to enable her to attempt a particular shot. In order to make a 12 foot shot, for example, she would have to be able to project the ball at an initial velocity of at least 24 feet per second, while in order to attempt a 16 foot shot she would have to be able to project it at a minimum of 26 feet per second.

It is desirable, therefore, to have a method of determining the speed at which a student can throw a basketball. In order to do this, the distance the ball travels from the point of release to the point of landing on the floor, and the time of ball flight must be known. The distance can be measured by tape measure or permanent floor or wall markings and the time of flight can be taken by stop watch.

The angle of projection of the throw is then calculated from the time and distance measurements by use of the equation

$$\tan \theta = \frac{\frac{1}{2} gt^2 + h}{d}$$

where θ—angle of projection

g—acceleration of gravity—32.172′/s/s

t—time of flight in secs.

h—height of release

d—horizontal distance from point of release to center of basket

The initial velocity can then be calculated from the equation

$$V_0 = \frac{d}{\text{Cos } \theta t}$$

where V_0—initial velocity.

Tables of initial velocities and of vertical angles of projection for varying times and distances can be calculated so that quick readings can be made in class.

The above measurements can, with student help, be made quickly and easily in a class situation.

If initially, a student is unable to throw a ball at the desired velocity she must, with the instructor's assistance, learn to do so. An almost continuous record of her progress toward the velocity goal has high learning and motivating value.

Although stop watches are by no means essential, they can, when available, be used to advantage, not only in determining the velocity of a throw but in checking the complete arc of flight. If, for example, the correct time of the ball's flight from release to basket level is known, a stop watch measurement of the actual time shows whether or not the shot was correct. If such measurements can be made, it is not essential that the student go back to the practice bar to check the accuracy of her performance.

The correct time of flight of the recommended 12 foot shot is 0.939 seconds and that of the recommended 16 foot shot is 1.028 seconds.

The writer is well aware of the fact that the suggestions offered in this article require further study and further application. However, it was felt that, as presented, they could be of value to teachers, and that the theses underlying them could be greatly advanced with the assistance of instructors who try them out.

ADDENDUM

Equations Applicable to the Study of Projectiles

Since this article was originally written for publication in a non-technical periodical, some of the methods and equations used in obtaining the results, are appended. These equations have been added with the thought that they would be of value to a reader who wishes to continue study along this line.

I. *Initial Velocity, Vertical Angle of Projection, and Time of Flight*

For the most part, calculations of initial velocity, vertical angle of projection, and time of flight can be made by use of the equations:

$$h = V_0t \, \text{Sin}\, \theta - \tfrac{1}{2}gt^2 \qquad (1)$$

$$d = V_0t \, \text{Cos}\, \theta \qquad (2)$$

$$\tan \theta = \frac{\tfrac{1}{2}gt^2 + h}{d} \qquad (3)$$

$$(V_0t)^2 = d^2 + (\tfrac{1}{2}gt^2 + h)^2 \qquad (4)$$

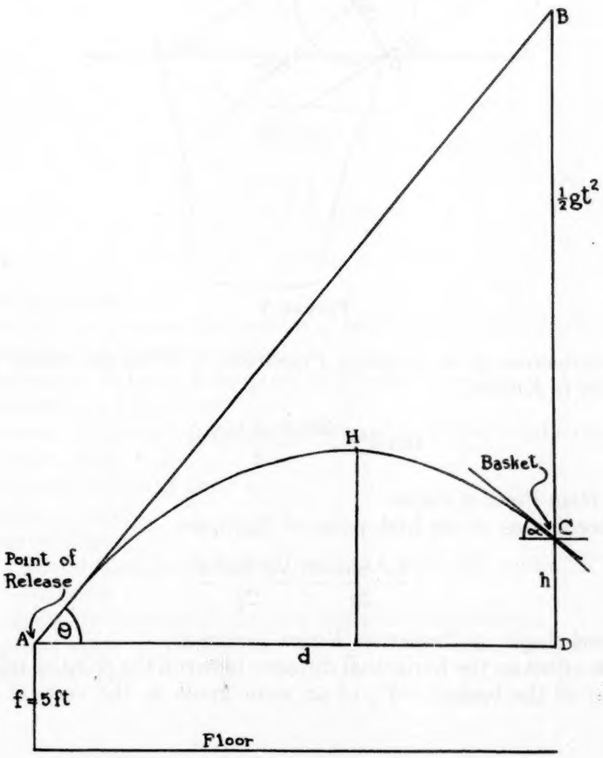

FIGURE IV

II. *Determination of the Limiting Angle of Flight at the Basket*

An approximation of the smallest angle to the horizontal at which the ball can reach the basket and still drop "cleanly" through has been termed the limiting angle at the basket.

This angle was determined as follows:

$$\text{Let } \angle KDL = \alpha$$
$$\angle KDL = \angle OBD = \alpha$$
$$\text{Sin } OBD = \frac{9.5}{18}$$
$$= .528$$
$$\therefore \alpha = 31^\circ\, 51^1$$

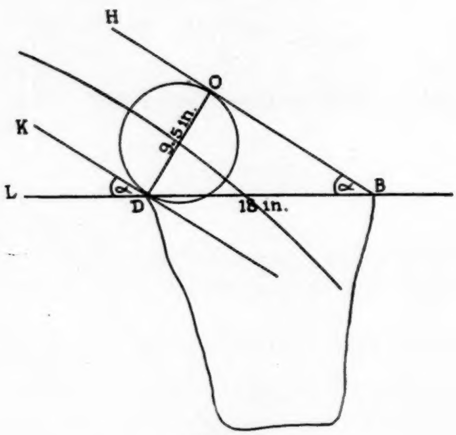

FIGURE V

III. *Determination of the Angle of Projection, θ, When the Angle, α, at the Basket is Known*

$$\tan\theta = \frac{2h + d\tan\alpha}{d}$$

IV. *The High Point of Flight*

The coordinates of the high point of flight are

$$\left\{\frac{V_0^2 \text{ Sin } 2\theta}{2g}, \frac{V_0^2 \text{ Sin}^2\, \theta}{2g}\right\}$$

V. *Vertical Angle of Projection Errors (assumed)*

(a) The effect on the horizontal distance between the point of release and the center of the basket, "d", of an error made in the vertical angle of

projection of a particular shot, when the initial velocity remained constant, was calculated (equations (1) and (2)).

(b) The Projected Width of the Basket and the Margin by Which the Ball Clears the Rim (first approximations)

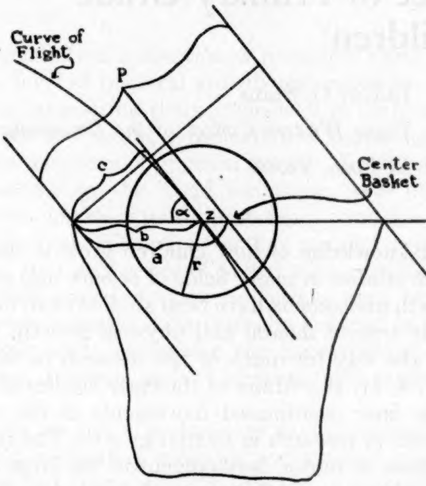

FIGURE VI

$$P = 2a \operatorname{Sin} \alpha$$
$$C_1 = c - r = b \operatorname{Sin} \alpha - r$$

Symbols

a = radius of basket
b = horizontal distance from center of ball to front rim of basket
C_1 = clearance of lower side of ball
d = horizontal distance from point of release to basket
g = acceleration of gravity
h = vertical distance from point of release to basket—taken as five feet in this study
P = projected width of basket
r = radius of ball
t = time of flight
z = horizontal distance between center of ball and center of basket at basket level
α = angle to the horizontal of curve of flight at the basket
θ = vertical angle of projection
V_0 = initial velocity

The Relationship Between Measures of Physical Growth and Gross Motor Performance of Primary-Grade School Children[1]

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Our knowledge of how children grow is steadily being advanced by research studies in many fields of science and education. Many aspects of the growth phenomena have been studied from birth to maturity. This is particularly true of mental and physical growth. Studies in these areas have paved the way for much of the research in the field of motor development (6, 7, 8, 11, 14). Many of the early studies of motor development involved the finer coordinated movements of the arm and fingers and were outgrowths of research in mental growth. The major proportion of research work done in motor development of the large muscle type has been confined to children under five years of age and to the preadolescent and adolescent level. Jenkins (9) emphasizes this when she states that the age group from three to 10 years represents a neglected area of research in motor development.

The primary-grade level would appear therefore to be a period where useful information might be gained concerning the motor development of children, particularly those phases which are associated with big muscle performance. Studies in the motor area carried on with primary-school children have been concerned chiefly with the finer motor coordinations involved in the use of the tracing board and the stylus maze (1, 2, 7, 13). Knowledge concerning the factors which influence motor performance of children during the primary-school years is likewise limited.

Considerable data exist with regard to physical growth at all age levels (3, 14, 15, 17, 19, 23, 24). An observation of the parallel paths depicted in the literature would indicate that the sequence of physical growth and the sequence of development in gross motor performance are concurrent developmental phenomena. It is therefore believed that knowledge of these sequences and their relationships would assist the teacher of physical education to provide activities conducive to the pupil's attainment of optimum growth and development.

[1] A more complete account of the study is contained in a dissertation that may be found in the library of the School of Education, Boston University. June 1948.

The purpose of this study has been to determine the relationships, if any, which exist between measures of physical growth and maturity of primary-school children and their proficiency in performing certain gross motor activities.

Procedure

The initial step involved a selection of measures which would be suitable for assessing the level of physical growth and maturity of primary-school children as well as appraising their proficiency in performing certain gross motor skills. Height and weight as indicators of increasing size were selected as being adequate measures of physical growth. X-rays of the carpal bones of the wrist, assessed by the Todd technique, were utilized as physical maturity indicators. Levels of motor proficiency were determined by a series of motor tests, all of which were of the "big muscle" type.

It was realized that any series of motor tests capable of giving a valid appraisal of the child's level of motor proficiency must be reasonably representative of the fundamental skills typically engaged in by children of this level. Seven motor areas embracing the fundamental skills of running, jumping, throwing, balance, agility, striking, and catching were selected for study.

It was necessary to run a preliminary investigation in order to select tests which would adequately measure performance in each of the seven motor areas. The test items initially selected involved those skills which are prominent in the play activities of the children of this age. However, in some cases items were selected from tests built for children at slightly younger and older age levels. These items were modified for adaptation to the age level of this investigation.

Items initially selected for measuring gross motor performance.

I. Running: The distances are varied to lend consideration to the variable factors of the start and fatigue, and their effect upon the reliability of performance.
   1. 20 yard dash
   2. 30 yard dash
   3. 35 yard dash
   4. 40 yard dash
   5. Baserunning—(Bases 25 feet apart)
   6. Adapted shuttle run (12) (Adapted from shuttle run)
   7. 50 foot hop

II. Throwing: The size of the ball was varied to determine that size which was best adapted to the small hands of young children.
   For accuracy:
   1. Target at a distance of ten feet.
      a. Baseball
      b. Twelve inch softball
      c. Tennis ball

2. Target at a distance of fifteen feet.
   a. Baseball
   b. Twelve inch softball
   c. Tennis ball

For distance:
1. Baseball
2. Twelve inch softball
3. Tennis ball

III. Jumping:
1. Jump and reach (9)
2. Jump and turn
3. Standing broad jump
4. Running broad jump

IV. Balance:
1. Balance beam
2. Balance blocks (6)
3. Hopping on one foot in place
4. Stick test (lengthwise and crosswise) (12)
5. Progressive stork stand (4)

V. Agility:
1. Potato race
2. Side stepping test (12)
3. Short potato race (12)
4. Run and over (5)
5. Run and under (5)

VI. Striking:
1. Hoop-controlled striking

   A hoop 14″ in diameter is suspended so that it is five feet from the ground. Two lines are marked on the ground five feet from either side of the plane of the hoop. A circle 18″ in diameter is marked off adjacent to one of these lines. A 12″ softball and a small child's baseball bat 20″ long with a slender grip increasing to approximately $1\frac{1}{2}''$ diameter at the striking end are the equipment used. The testee is placed according to his handedness outside the circle on the ground. The tester takes his position at the opposite line. The ball is tossed through the hoop so that it would land in the circle on the ground. Performance is scored in terms of the number of successful hits scored on 10 pitches. (A successful hit is hit forward. It is not a "tick").

2. Pendulum-controlled striking

   A device constructed of an upright $6\frac{1}{2}'$ in height with a braced perpendicular arm $3\frac{1}{2}'$ in length extending from the top is secured in a 3′ by 3′ platform. All of the wood in this device is 2″ by 4″ stock. A hook is secured into the underside of the perpendicular arm. A light chain, adapted for use from a small child's trapeze, is secured by an open link to the hook. A 12″ softball is securely

attached to the chain by using a rawhide thong. Note: The height of the ball can be varied by placing the hook through different links of the chain. The same bat as utilized in hoop-controlled striking is used.

The testee is placed in batting position opposite the upright. The tester then takes his position, depending upon the handedness of the testee, and draws the ball back to the level of his chin. The ball is released and the testee tries to strike it. This item was scored in terms of the number of successful strikes made out of the 10 trials. Contact of the bat with the ball was considered a successful strike. The height of the ball was varied to prevent a grooved swing.

3. Kicking rolled soccer ball
4. Controlled-volleyball striking with arm
5. Controlled tennis ball striking with racket

VII. Catching:

1. Hoop-controlled catching: Due to the small hand size in children of this age, balls of various sizes and weights were used in order to check the reliability of performance of each.

   The equipment and controls were arranged in the same fashion as for the hoop-controlled striking. The testee was placed in the center of the 18″ diameter circle drawn on the ground. The ball was tossed through the hoop by the tester in such a way that it would land in the circle on the ground. Ten trials with each type ball were attempted. Performance was scored in terms of the number of successful catches made on the 10 attempts.

   a. Softball
   b. Squashball
   c. Tennis ball
2. Wall toss and catch
3. Over line toss and catch

CRITERIA FOR THE SELECTION OF ITEMS TO BE USED IN THIS INVESTIGATION.

1. A test to be retained must offer no possibility of injury to the child.
2. The degree of difficulty of a test item must be such that it will enable every child to give a performance which can be scaled from poor to superior achievement.
3. Items which most clearly discriminate between poor and superior performances as indicated by a wider range of performance scores are considered highly important.
4. Simplicity in terms of the ease of child-comprehension of the task is considered highly important.
5. The best response of each child is sought. Items which present administration difficulties which possibly could interfere with performance are eliminated.

6. Test items which involve much time and effort by the child and promote undue fatigue are considered to interfere with reliable performance.
7. Items involving the simplest of equipment are considered most desirable.
8. Items which prove to be most reliable in a test-retest situation are considered superior test items.

Applying the criteria for test selection, each of the compiled test items were tried on a group of 10 children. This trial run purported to discover those items which involved certain hazards, were too easy or too difficult, and those tests in which verbal instructions would give each item objectivity and promote the best response from each child. Two items, the run-and-over and the run-and-under, were found to be somewhat hazardous. The item, kicking a rolled soccer ball, was considered as too uncontrollable and yielded varying results. Striking a volleyball with the arm and striking a tennis ball with a racket were considered too easy for yielding discriminatory results. The controlled wall toss and catch was found to be too difficult for the younger children of this group. These items were discarded from the group of compiled test items.

The items in the compiled list were considered as valid instruments for their intended use due to the similarity between the kinesiology of movement employed in the test and that in the performance area being measured. It can be observed that the items in the compiled list are measuring a particular area of motor performance in a direct manner. To measure performance in running, a running situation is utilized. It is readily recognized, however, that variable factors would tend to weaken the instrument extensively, unless a highly objective set of directions was applied consistently to each item.

The final step of the preliminary experiment involved the administration of the remainder of the items to 37 girls and 38 boys, age range 6 years no months to 8 years 11 months. These same children were then retested with the same items. The time interval between the initial test and the retest was only a few hours in 73 cases. The other two individuals were retested on successive Thursdays. Children were tested in groups of two by two testers. Performance scores of the first trial were correlated with performance scores of the second trial using the Pearson Product Moment Method of Correlation (20). The reliabilities found are indicated in Table 1.

The data for the study were gathered by obtaining measures of physical growth and gross motor performance on 510 primary-grade children in the public schools of four Massachusetts communities.

Four testers were employed upon each occasion of testing. Each of the testers was a physical education major and received a period of instruction and a period of observing before participating in the testing. Each child was encouraged to do his best, but there was no competition involved in the test items. The instructions for giving the test item indicate the number of trials included in the administration of each particular item. Each tester was alert to note any factor which might interfere with the best perform-

TABLE 1

Reliability of compiled items as determined by correlating first and second trials

TEST ITEM	COEFFICIENT OF CORRELATION
Running	
20 yard dash	.803
30 yard dash	.856
35 yard dash	.896
40 yard dash	.904*
Baserunning	.736
Adapted shuttle run	.796
50 foot hop	.869
Throwing for accuracy	
Target at a distance of 10 feet	
Baseball	.592
12″ softball	.777
Tennis ball	.869
Target at a distance of 15 feet	
Baseball	.770
12″ softball	.588
Tennis ball	.604
Throwing for distance	
Baseball	.970
12″ softball	.953
Tennis ball	.980*
Jumping	
Jump and reach	.874
Jump and turn	.695
Standing broad jump	.906*
Running broad jump	.913
Balance	
Balance beam	.471
Balance blocks	.318
Hopping on one foot in place	.496
Stick test lengthwise	.789*
Stick test crosswise	.497
Progressive stork stand	.798
Agility	
Potato race	.576
Sidestepping	.956*
Short potato race	.809
Striking	
Hoop-controlled striking	.735
Pendulum-controlled striking	.696*
Catching	
Hoop-controlled catching softball	.887
Hoop-controlled catching squash ball	.91
Hoop-controlled catching tennis ball	.931*
Over line toss and catch	.922

* Items selected to be used in experiment.

Recording: Dash scored in seconds and tenths of seconds.
Balance scored in seconds and tenths of seconds.
Sidestep scored in total number of times testee shuttles back and forth over each area during a period of 10 seconds.
Jump scored in inches.

Recording: Throws measured in terms of total distance of three throws to the nearest half-foot.
Striking scored in terms of number of successful attempts out of 10 trials.
Catching scored in terms of number of successful catches out of 10 attempts.

ance of the child. Whenever any such factor was noted a retest was administered. This, however, occurred on only seven occasions.

Each test item was administered individually. With four men testing, it was possible to administer two test items simultaneously. There was no set order for the administering of the test items except that the 40 yard dash and the sidestepping test were never administered successively. The children were brought to the testing area by grades so that no child was administered two successive items without opportunity to rest.

The birthdate of each child was secured from the school records. Age was computed to the nearest month on the day the child's test was completed. If the child was 15 or more days advanced into the next month of age, those days were recorded as a full month of age. Standard procedures were utilized in measuring height and weight. Height was recorded in inches and weight recorded in pounds.

Carpal X-rays were secured on all but four of the primary-grade students of a single elementary school. These four students were absent the day the X-rays were taken. A Boston physician, specializing in roentgenograms was engaged for this purpose. Portable equipment and two technicians completed this task at the school.

The data gathered, exclusive of the carpal X-rays, was classified into two variables, physical growth and motor performance, by sex and by grade. The mean and standard deviation of each item within each variable, for each sex and for each grade, were computed (20).

The height, weight, and gross motor performance data were then classified into three-month age intervals. A separate group of intervals was provided for each sex (16). The data were then regrouped into grades and the zero order correlation of each physical growth variable, exclusive of carpal X-rays, was calculated, as was each measure of motor performance using the Pearson Product Method of Correlation (20).

The carpal X-rays were then assessed by using the Todd technique (21). For the purpose of determining the reliability and validity of the writer's assessment, they were assessed twice by the writer and once by a person[2] with experience in the areas of physiology, anatomy, and child development. The time interval between the writer's first and second assessment was one week. During this time interval the other rater assessed the X-ray plates (20). The coefficients of correlation found were:

Writer's First Assessment and Assessment of Experienced Individual	+.85
Writer's Second Assessment and Assessment of Experienced Individual	+.85
Writer's First Assessment and Writer's Second Assessment	+.87

On the basis of the above correlations the writer's second assessment was selected. The scores of this assessment were then correlated with the

[2] G. Lawrence Rarick, Associate Professor of Education, Boston University, Boston, Massachusetts.

motor performance scores of the group of children X-rayed. For these correlations the data were segregated by sex (20).

ANALYSIS OF DATA BY GRADE LEVEL

Means and standard deviations were computed for each grade and each sex for each measure of physical growth and motor performance.

TABLE 2

Means and standard deviations of physical growth and motor performance of first, second, and third-grade boys

	GRADE I N = 89		GRADE II N = 93		GRADE III N = 90	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Physical growth						
Age	78.93	4.98	91.03	6.71	103.40	7.16
Height	47.75	2.30	50.90	2.16	53.38	2.34
Weight	51.82	6.50	58.94	6.92	67.43	10.95
Motor performance						
Dash	9.30	1.20	8.28	.66	7.97	.60
Stick test	5.02	4.04	7.59	6.69	9.19	8.22
Sidestep	9.10	1.50	9.60	1.31	11.00	1.52
Jump	34.97	6.60	38.45	5.92	44.00	6.12
Ball throw	137.86	50.40	176.04	51.94	216.06	57.34
Striking	4.70	2.60	5.40	2.24	5.60	2.01
Catching	6.60	2.50	8.40	1.70	9.00	1.50

TABLE 3

Means and standard deviations of physical growth and motor performance of first, second, and third-grade girls

	GRADE I N = 67		GRADE II N = 89		GRADE III N = 82	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Physical Growth						
Age	78.35	4.74	89.88	5.14	101.57	5.60
Height	46.95	1.79	49.80	2.46	52.10	2.42
Weight	49.19	7.90	58.32	12.87	61.67	9.28
Motor Performance						
Dash	9.51	1.12	9.0	.89	8.64	.69
Stick test	5.17	5.61	5.07	5.42	10.50	9.42
Sidestep	8.90	1.44	9.79	2.66	10.59	1.52
Jump	35.62	5.45	35.22	6.51	41.96	6.93
Ball throw	71.66	27.09	82.14	30.78	108.01	33.68
Striking	4.33	1.84	4.46	1.69	5.33	1.73
Catching	6.43	2.48	7.61	2.08	9.81	1.58

As shown in Table 1 the average ages of the boys were found to increase approximately 12 months from Grades I to II and from II to III. The ranges of ages found in the second and third grades was somewhat greater than that found in the first grade.

Average height and weight of boys increased with an almost constant increment from the first grade to the third grade. The standard deviations

of height and weight for each grade level were very similar with the exception of the weight of third-grade boys. In the same table the averages of the scores of motor performance provide similar increments from grade to grade. It should be noted that a decrease in the mean performance time on the 40 yard dash indicates an increase in proficiency.

Table 3 indicates that the means and standard deviations of girls in the first three grades follow approximately the same general patterns as do those reported in Table 2 for the boys. The means of performance on the stick test lengthwise by first- and third-grade girls and sidestepping test by second-grade girls may have been affected by extreme scores.

TABLE 4

Means and standard deviations of physical growth measures of primary-grade boys classified into three-month age intervals

AGE INTERVAL	HEIGHT		WEIGHT		N
	Mean	S.D.	Mean	S.D.	
73–75	47.09	4.03	51.89	7.82	16
76–78	47.47	1.96	51.61	5.74	22
79–81	48.21	2.2	52.88	6.57	13
82–84	48.66	2.67	53.41	6.56	22
85–87	49.55	2.62	57.13	6.63	20
88–90	51.0	2.52	60.19	8.49	24
91–93	49.95	2.35	57.78	6.14	16
94–96	51.63	1.84	63.23	11.1	12
97–99	52.71	2.18	63.38	6.57	21
100–102	52.78	2.54	64.84	9.02	16
103–105	52.51	2.61	69.0	13.95	17

ANALYSIS OF DATA GROUPED INTO THREE-MONTH AGE INTERVALS: SUMMARY OF TEST SCORES AND PHYSICAL GROWTH DATA CONSIDERED BY GRADE AND BY THREE-MONTH INTERVALS.

An examination of the means of physical growth and gross motor performance of boys and girls in Grades I, II, and III, as shown by Tables 2 and 3 provides evidence for a few general conclusions: (a) The average height, weight and age of boys in each grade was greater than that of the girls. This is in agreement with other investigations (14, 15). (b) The range of each of these physical growth characteristics was greater for the boys than for the girls. (c) Higher mean gross motor performance test scores and higher mean growth measures were evidenced by both sexes at successive grade levels.

By examining the data in Tables 4 and 6 when grouped into three-month age intervals, the same general observations of constant growth in height and weight may be made. Mean running performance scores progressed with each successive three-month age group for boys, but did not provide a similar pattern for girls (See Tables 5 and 7). The average performances of the boys and the girls in jumping showed little constant progression with each succeeding three-month age interval. There appears to be little evidence that there is a constant increase of average proficiency in pen-

TABLE 5

Means and standard deviations of motor skill performance data of primary-grade boys classified into three-month age intervals

AGE INTERVAL	RUNNING		BALANCE		AGILITY		JUMPING		THROWING		STRIKING		CATCHING		N
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	
73–75	9.99	1.45	3.56	3.63	8.94	.84	35.5	2.62	135.81	38.06	4.31	1.9	6.38	2.16	16
76–78	9.36	1.09	5.12	3.40	9.00	1.48	35.82	5.76	148.66	45.25	4.18	2.09	6.55	2.61	22
79–81	8.26	.77	6.15	4.34	9.77	1.39	35.31	8.06	143.88	52.04	5.15	1.89	7.46	1.99	13
82–84	9.09	1.26	6.96	5.31	9.00	1.00	33.66	5.95	141.11	40.75	4.59	1.8	6.82	2.10	22
85–87	8.5	.67	6.21	4.62	9.35	1.24	38.35	5.12	194.28	42.39	5.45	2.25	8.25	1.81	20
88–90	8.39	1.02	8.69	7.69	9.33	1.74	36.79	7.33	153.67	44.54	5.79	1.82	8.17	1.58	24
91–93	8.19	.67	5.48	3.29	10.38	1.23	38.66	6.76	167.69	45.33	4.69	2.19	8.56	1.08	16
94–96	8.28	.47	12.03	10.79	10.58	1.68	42.17	4.69	213.04	45.61	5.17	1.5	8.67	1.68	12
97–99	8.1	1.82	7.32	6.75	10.29	1.52	42.1	6.67	196.33	46.29	5.52	2.14	8.48	1.48	21
100–102	7.82	.53	8.52	5.42	11.13	1.46	43.0	7.2	193.81	96.56	4.94	2.01	8.5	1.77	16
103–105	7.77	.63	11.66	10.47	10.94	1.25	43.06	6.22	224.18	37.22	5.82	2.21	9.41	.93	17

TABLE 6

Means and standard deviations of physical growth measures of primary-grade girls classified into three-month age intervals

AGE INTERVAL	HEIGHT		WEIGHT		N
	Mean	S.D.	Mean	S.D	
71–73	45.59	1.69	46.64	2.57	11
74–76	46.85	1.33	49.31	8.71	17
77–79	46.84	2.02	51.0	5.04	14
80–82	47.73	1.93	50.6	6.0	20
83–85	48.68	1.49	54.03	9.02	23
87–89	48.29	2.78	50.06	9.2	20
90–91	50.14	1.98	61.0	7.57	23
92–94	51.12	.62	65.81	12.71	21
95–97	51.07	2.71	60.17	13.19	18
98–100	51.47	2.27	59.16	7.31	25
101–103	51.96	2.60	64.68	12.0	14
104–106	52.61	2.22	63.19	13.96	18

TABLE 7

Means and standard deviations of motor skill performance data of primary-grade girls classified into three-month age intervals

AGE INTERVAL	RUNNING		BALANCE		AGILITY		JUMPING		THROWING		STRIKING		CATCHING		N
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	
71–73	9.49	.93	3.1	2.18	8.45	1.27	32.27	4.94	57.14	25.67	3.36	1.5	5.27	3.05	11
74–76	9.9	1.19	3.68	3.61	9.29	1.26	34.06	4.66	71.97	25.39	4.59	1.57	5.88	2.2	17
77–79	9.6	1.08	4.16	2.26	8.71	1.41	36.36	5.54	74.14	35.4	4.29	1.7	6.86	2.19	14
80–82	9.18	1.15	5.85	7.1	8.85	1.24	35.75	5.56	76.55	17.0	4.65	2.01	6.75	2.43	20
83–85	9.01	.64	4.67	6.48	9.48	1.58	37.65	7.84	79.85	40.45	5.09	1.37	7.13	2.46	23
86–88	9.02	.82	4.14	3.28	9.15	1.46	35.65	5.3	85.1	24.9	3.8	1.93	7.9	1.93	20
89–91	9.23	1.04	7.63	8.36	9.7	1.08	34.83	6.72	76.04	13.09	4.65	1.87	7.65	2.04	23
92–94	8.65	.24	7.19	6.1	9.19	1.53	35.5	5.87	89.36	29.25	4.76	1.57	8.67	1.40	21
95–97	8.72	.66	4.55	2.62	10.17	1.58	39.67	7.05	92.70	28.37	5.44	2.13	7.72	1.97	18
98–100	8.95	.79	9.01	6.92	10.24	1.5	38.36	6.57	94.14	23.14	4.76	1.75	8.84	1.46	25
101–103	8.34	.5	8.93	3.11	10.71	1.77	44.71	7.13	121.21	36.87	4.64	.98	8.86	1.28	14
104–106	8.46	.62	13.86	10.33	10.72	1.21	43.39	7.97	130.5	48.64	6.22	1.32	8.78	1.74	18

dulum-controlled striking by either boys or girls at successive three-month intervals. The average catching performance improves with almost every successive three-month age interval.

Physical growth and gross motor performance of primary-grade boys and girls have been described in terms of means and standard deviations of measurements taken on children at various chronological ages. Through this technique, certain patterns of physical growth and gross motor performance of first, second, and third-grade children have been portrayed.

TABLE 8

Zero-order correlations between gross motor performance test scores and physical growth measures applied to boys in primary grades
Pearson product moment method

MOTOR PERFORMANCE TEST ITEM	AGE	HEIGHT	WEIGHT
Grade One N = 89			
40 yard dash	+.259	+.250	+.097
Stick test lengthwise	+.147	−.167	−.045
Sidestepping	−.026	−.029	−.028
Standing broad jump	+.009	+.005	−.001
Throwing for distance	+.067	+.005	+.063
Pendulum-controlled striking	+.013	−.110	−.118
Hoop-controlled catching	+.221	+.055	−.043
Grade Two N = 93			
40 yard dash	+.373	+.058	−.078
Stick test lengthwise	+.129	−.028	−.073
Sidestepping	+.207	−.102	−.024
Standing broad jump	+.283	+.127	−.057
Throwing for distance	+.205	+.016	−.105
Pendulum-controlled striking	+.102	+.368	+.159
Hoop-controlled catching	+.208	+.173	+.014
Grade Three N = 90			
40 yard dash	+.055	+.027	+.064
Stick test lengthwise	+.004	+.212	+.127
Sidestepping	+.122	−.160	−.234
Standing broad jump	+.088	+.114	−.003
Throwing for distance	+.068	+.098	+.157
Pendulum-controlled striking	−.031	+0.37	−.077
Hoop-controlled catching	+.183	+.294	+.283

In the light of the description one might assume that some relationship exists between gross motor performance and physical growth measures. The correlation technique has been used in an effort to determine the relationships which exist. These relationships are indicated in Table 8.

ANALYSIS OF DATA BY ZERO-ORDER CORRELATIONS:

Tables 8 and 9 indicate little or no relationship between gross performance test scores and measures of physical growth by use of the Zero-Order Correlation technique. It must be recognized that certain hidden variables are not accounted for with the use of this technique. The Partial-Correlation technique, therefore, is employed in an effort to eliminate hidden variables not accounted for in the previous correlations.

Almost without exception there are very low partial correlations indicated in Table 10 between gross motor performance test scores and physical growth data.

For further refinement in determining the relationship between gross motor performance test scores and measures of physical growth partial correlations of the second order were calculated.

TABLE 9

Zero-order correlations between gross motor performance test scores and physical growth measures applied to girls in primary grades
(Pearson product moment method)

MOTOR PERFORMANCE TEST ITEM	AGE	HEIGHT	WEIGHT
Grade One N = 67			
40 yard dash	+.159	+.145	−.202
Stick test lengthwise	+.422	+.167	+.069
Sidestepping	−.033	+.078	−.134
Standing broad jump	+.246	+.242	+.164
Throwing for distance	+.139	+.137	+.031
Pendulum-controlled striking	+.225	+.001	−.031
Hoop-controlled catching	+.297	+.150	−.087
Grade Two N = 89			
40 yard dash	+.043	+.053	−.056
Stick test lengthwise	+.091	−.048	−.060
Sidestepping	+.096	−.231	−.132
Standing broad jump	−.029	−.210	−.274
Throwing for distance	+.126	−.025	−.002
Pendulum-controlled striking	−.134	−.025	−.099
Hoop-controlled catching	+.024	+.056	−.023
Grade Three N = 92			
40 yard dash	+.205	−.059	−.131
Stick test lengthwise	+.005	+.124	−.128
Standing broad jump	+.125	−.053	−.181
Sidestepping	+.005	+.142	−.166
Throwing for distance	+.197	+.134	−.119
Pendulum-controlled striking	−.010	+.237	−.086
Hoop-controlled catching	−.040	+.141	+.129

ANALYSIS OF DATA BY PARTIAL-CORRELATIONS:

Table 11 portrays little or no relationship between motor performance Test Scores and Physical Growth Data when Partial Correlation of the second order is applied.

Due to certain limitations X-rays of the carpal areas of only 63 boys and girls were available. These X-ray plates were assessed according to the Todd technique (21). The evaluations, as expressed by Todd's standards of skeletal maturity, were then correlated with the gross motor performance test scores of boys and girls.

Table 12 shows the results of Zero-Order Correlations between gross motor performance test scores and a measure of skeletal maturity. The running and sidestepping test scores of boys, and the jumping test scores of girls show a moderately high relationship with skeletal maturity. The

stick test lengthwise scores of both boys and girls and the pendulum-controlled striking test scores of girls show a very low relationship with the measure of skeletal maturity. The remainder of the test scores show a

TABLE 10

Partial correlations between motor performance test scores and physical growth data

	GRADE 1		GRADE 2		GRADE 3	
	Boys	Girls	Boys	Girls	Boys	Girls
Motor Performance Test and Age with Height Held Constant						
40 yard dash	+.251	+.123	+.427	+.027	+.051	+.207
Stick test lengthwise	+.156	+.395	+.150	+.038	−.029	+.001
Sidestepping	−.025	−.029	+.265	+.182	+.127	+.010
Standing broad jump	+.009	+.188	+.252	−.025	+.072	+.127
Throwing for distance	+.067	+.104	+.213	+.141	+.054	+.196
Pendulum-controlled striking	+.014	+.236	−.041	−.133	−.037	−.009
Hoop-controlled catching	+.220	+.307	+.156	+.006	+.146	−.145
Motor Performance Test and Height with Age Held Constant						
40 yard dash	+.248	+.104	−.094	+.042	+.019	−.067
Stick test lengthwise	−.177	+.049	−.077	−.054	+.213	+.124
Sidestepping	−.028	+.092	−.197	−.276	−.182	−.142
Standing broad jump	+.005	+.183	+.035	−.126	+.103	−.057
Throwing for distance	+.002	+.101	−.066	−.068	+.089	+.131
Pendulum-controlled striking	−.111	−.073	+.357	+.018	+.043	+.238
Hoop-controlled catching	+.046	+.067	+.105	+.051	+.274	+.142
Motor Performance Test and Weight with Age Held Constant						
40 yard dash	+.079	−.214	−.094	−.071	+.058	−.121
Stick test lengthwise	−.058	+.050	−.105	−.090	+.064	−.128
Sidestepping	−.026	−.132	−.076	−.168	−.223	−.166
Standing broad jump	.000	+.155	−.130	−.278	−.013	−.175
Throwing for distance	+.059	+.044	−.157	−.004	+.150	−.109
Pendulum-controlled striking	−.119	−.019	+.140	−.063	−.074	−.087
Hoop-controlled catching	−.063	−.109	−.037	−.033	+.268	+.127
Motor Performance Test and Weight with Height Held Constant						
40 yard dash	+.109	−.170	−.053	−.100	+.060	−.118
Stick test lengthwise	+.082	+.024	−.071	−.093	+.001	−.229
Sidestepping	−.015	−.163	+.050	+.091	−.283	−.180
Standing broad jump	−.005	+.104	−.180	−.351	−.089	−.180
Throwing for distance	+.078	+.015	−.146	.000	+.123	−.224
Pendulum-controlled striking	−.062	−.032	−.091	−.168	−.123	−.254
Hoop-controlled catching	−.102	−.095	−.118	−.045	+.142	+.065

slight tendency to correlate with the measure of skeletal maturity. It is perhaps noteworthy that all of the coefficients of correlation in Table 12 are positive.

TABLE 11

Partial correlations of the second order between motor performance test scores and physical growth data

	GRADE I		GRADE II		GRADE III	
	Boys	Girls	Boys	Girls	Boys	Girls
Motor Performance Test Scores and Age with Height and Weight Held Constant						
40 yard dash	+.245	+.120	+.428	+.036	+.049	+.188
Stick test lengthwise	+.151	+.396	+.151	+.092	−.029	−.021
Sidestepping	−.024	−.065	+.273	+.158	+.142	.000
Standing broad jump	+.009	+.192	+.259	+.165	+.075	+.112
Throwing for distance	+.061	+.104	+.216	+.159	+.050	+.180
Pendulum-controlled striking	+.018	+.235	−.040	−.063	−.033	−.033
Hoop-controlled catching	+.299	+.306	+.159	+.030	+.143	−.039
Motor Performance Test Scores and Height with Age and Weight Held Constant						
40 yard dash	+.258	+.172	−.044	+.156	−.019	−.004
Stick test lengthwise	−.183	+.036	−.011	+.026	+.216	+.228
Sidestepping	−.014	+.134	−.254	−.236	−.065	−.064
Standing broad jump	+.007	+.148	+.160	+.153	+.149	+.042
Throwing for distance	−.047	+.103	+.048	−.104	+.001	+.223
Pendulum-controlled striking	−.046	−.071	+.463	+.108	+.106	+.336
Hoop-controlled catching	+.159	+.101	+.170	+.122	+.150	+.089
Motor Performance Test Scores and Weight with Age and Height Held Constant						
40 yard dash	−.108	−.252	−.044	−.167	+.058	−.096
Stick test lengthwise	+.074	+.039	−.132	−.077	−.077	−.241
Sidestepping	−.001	−.164	+.070	+.080	−.146	−.108
Standing broad jump	−.004	+.111	−.202	−.291	−.026	−.171
Throwing for distance	+.078	+.017	−.151	+.079	+.121	−.211
Pendulum-controlled striking	−.063	+.001	−.131	−.123	−.122	−.258
Hoop-controlled catching	−.121	−.132	−.139	−.117	+.137	+.062

TABLE 12

Zero-order correlations between motor performance test scores and a measure of skeletal maturity of primary-grade boys and girls

MOTOR PERFORMANCE TEST	MEASURE OF SKELETAL MATURITY	
	Boys	Girls
40 yard dash	+.51	+.46
Stick test lengthwise	+.07	+.034
Sidestepping	+.55	+.43
Standing broad jump	+.27	+.56
Throwing for distance	+.42	+.38
Pendulum-controlled striking	+.26	+.02
Hoop-controlled catching	+.45	+.49

Summary and Conclusion

Running: With an analysis of the data in terms of each grade level, it was found that the mean performance of both boys and girls becomes higher at each successive grade level.

An analysis of mean running performance of boys and girls classified into three-month intervals of age showed a rather constant increase of mean performance from the youngest age interval to the oldest age interval. There was also a narrower range of performance found in the older age intervals. Zero-Order Correlations show little or no relationship between running performance scores and weight in the first, second, and third grades. There was a slight tendency for running performance scores to correlate positively with age for boys in Grades I and II. The Partial Correlation technique showed a slight tendency for a positive correlation to exist between running performance and age with height held constant. Partial Correlation of the Second Order between running performance and age with height and weight held constant provided a similar result. The highest correlation of any of the measures of physical growth and maturation with running performance was that of skeletal maturity with a correlation of +.51.

Balance: Performance in balance was measured by use of the stick test lengthwise. The mean performance of second-grade boys was superior to the mean performance of first-grade boys. The mean performance of third-grade boys was superior to that of second-grade boys. The mean performance of girls in the first two grades was nearly identical, while the mean performance in balance of the third-grade girls more than doubled that in either of the first two grades.

By examining mean performance of balance by boys classified into three-month age groups, an increased mean performance was found with successive age groups. This relationship was not the same for girls. In test scores of both sexes performance in balance is accompanied by a very large standard deviation. Balance performance of the first-grade girls showed a slight tendency to correlate positively with age. This relationship remained approximately the same when the Partial Correlation techniques were applied to the data. There was a very low relationship between balance, as measured by the stick test lengthwise and a measure of skeletal maturity.

Agility: Agility was measured in this study by use of a modified side-stepping test. The mean performance of the boys and the girls showed an increase at successive grade levels. The boys classified into three-month age groups showed a steady increase in mean performance at successive age intervals, while the mean performances of the girls did not. Sidestepping test scores showed a very low correlation with age, height and weight. The correlations with weight were constantly negative but very low. A moderately high positive relationship was found between boys' agility performance test scores and a measure of skeletal maturity. Girls' agility performance test scores showed a +.43 correlation with a measure of skeletal maturity.

Jumping: In this study performance in jumping was measured by the standing broad jump. The mean performance of boys showed an increase at successive grade levels. The mean performance of girls remained almost the same in the first and second grade, but increased at the third-grade

level. There was no constant increase in the mean performance score of jumping by boys or girls classified into three-month age groups. No significant coefficients of correlation were found between jumping performance and age or height. There were constant negative relationships between jumping performance and weight. A partial correlation of −.351 was noted between jumping scores and weight with height held constant. A moderately high positive relationship was noted between girls' performance in jumping and a measure of skeletal maturity. The correlation between boys' scores in jumping and measure of skeletal maturity produced only a slight relationship.

Throwing: Throwing performance in this study was measured by a tennis ball throw for distance. Mean throwing performance of boys and girls showed a very definite increase at each successive grade level. Mean throwing performance of boys classified into three-month age groups showed little evidence of consistent increases. The mean performance of throwing by girls showed a definite tendency to increase with each successive three-month age interval. A very low insignificant relationship was found between throwing performance and age, height, and weight. Correlations of +.42 for the boys, and +.38 for the girls were found between throwing performance and a measure of skeletal maturity.

Striking: Striking performance was measured in this study by use of pendulum-controlled striking. Mean performance in striking showed a constant increase on the part of boys and girls at successive grade levels. Mean performances with boys and girls classified into three-month age groups gave no evidence of consistent increases with successively older age groups. Pendulum-controlled striking performance of second-grade boys showed a +.368 correlation with height. When age and weight were held constant this correlation increased to +.463. Striking performance of third-grade girls showed a tendency to correlate with height when age and weight were held constant. A coefficient of correlation of +.26 for boys and −.02 for girls was found between striking performance and a measure of skeletal maturity.

Catching: Catching performance in this study is measured by hoop-controlled catching. The mean performance in catching of boys and girls increased at each successive grade level. Boys and girls classified into three-month age groups evidenced an increase in mean performance with successive age groups. A slight relationship was found between catching performance and height and weight with third-grade boys. The coefficients of correlation between catching performance and a measure of skeletal maturity is +.45 for boys and +.49 for girls.

The 510 primary grade boys and girls studied in this experiment were taller, heavier, and older at each higher grade level. The mean performance by these children in the gross motor skills considered in this study was greater at each higher grade level. By examining the performance in a narrower age grouping varied results were obtained. The correlation technique indicated little or no relationship between the gross motor skill performance of primary-grade children and their age, height, or weight.

Correlations between a measure of maturity and certain gross motor skill performance indicated some relationships. Upon considering the many factors which may influence motor performance, the relationships between skeletal maturity and motor performances although they are not great, may be lent more significance.

REFERENCES

1. BAYLEY, N. "The Development of Motor Abilities During the First Three Years." Monograph of Sociological Research, *Child Development*, 1935.
2. BAYLEY, N. AND ESPENCHADE, A. "Motor Development from Birth to Maturity." *Review of Educational Research*, Vol. 11, No. 5, 1941.
3. BOYNTON, B. *The Physical Growth of Girls*. Studies in Child Welfare, Vol. 12, No. 4. University of Iowa, 1936.
4. BRACE, D. D. *Measuring Motor Ability*. New York: A. S. Barnes and Co., 1927.
5. CARPENTER, A. "The Measurement of General Motor Capacity and General Motor Ability in the First Three Grades" *Research Quarterly*, Vol. 13, No. 4, December 1942.
6. CUNNINGHAM, B. V. "An Experiment in Measuring Gross Motor Development of Infants and Young Children." *Journal of Educational Psychology*, 1927.
7. GOODENOUGH, F. L. "The Development of Reactive Process from Early Childhood to Maturity." *Journal of Experimental Psychology*, Vol. 18, 1935.
8. GUTTERIDGE, M. "A Study of Motor Achievements of Young Children." *Archives of Psychology*, New York, 1939.
9. JENKINS, L. M. *A Comparative Study of Motor Achievements of Children of Five, Six and Seven Years of Age*. New York: Teachers College, Columbia University, 1930.
10. JONES, T. D. "The Development of Certain Motor Skills and Play Activities in Young Children." *Child Development Monograph*, Vol. 26, New York: Teachers College, Columbia University, 1939.
11. MCCASKILL, C. L., AND WELLMAN, B. "A Study of Common Motor Achievements at Preschool Ages." *Child Development*, Vol. 9, 1938.
12. MCCLOY, C. H. *Tests and Measurements in Health and Physical Education*. Second edition. New York: F. S. Crofts and Co., 1944.
13. MCGINNIS, E. "A Child's StylusMaze." *American Journal of Psychology*, Vol. 40, 1928.
14. MEREDITH, H. V. "Bodily Changes in Adolescence." *Hygeia*, Vol. 16, 1938.
15. MEREDITH, H. V. *The Rhythm of Physical Growth*. Studies in Child Welfare, Vol. 11, No. 3, University of Iowa, 1936.
16. PIETMAN, J. G. *Descriptive and Sampling Statistics*. New York: Harper and Brothers, 1947.
17. PRYOR, H. B., AND STOLZ, H. R. "Determining Appropriate Weight for Body Build." *The Journal of Pediatrics*, Vol. 3, No. 4, October 1933.
18. RARICK, L. "An Analysis of the Speed Factor in Simple Athletic Activities." *Research Quarterly*, Vol. 8, No. 4, December 1937.
19. SHUTTLEWORTH, F. K. "Sexual Maturation and the Physical Growth of Girls Aged Six to Nineteen." *Child Development*, Vol. 11, No. 5, 1937.
20. SORENSON, H., *Statistics for Students of Psychology and Education*. New York: McGraw-Hill, 1936.
21. TODD, T. W. *Atlas of Skeletal Maturation*. St. Louis: C. V. Mosby, 1937.
22. VICKERS, V. S.; POYNTS, L.; AND BAUM, M. P. "The Brace Scale Used with Young Children." *Research Quarterly*, Vol. 13, No. 3, October 1942.
23. WETZEL, N. C. "On the Motion of Growth." *Journal of Pediatrics*, Vol. 4, 1934.
24. WETZEL, N. C. "Physical Fitness in Terms of Physique, Development and Basal Metabolism, with a Guide to Individual Progress from Infancy to Maturity, A New Method for Evaluation." *Journal of the American Medical Association*, Vol. 116, No. 12, 1941.

Guide to Authors

IN line with the overall goal of making Association publications yield the greatest value to the individual and profession, the following is a yardstick for the preparation of research manuscripts. The information as spelled out below recognizes general techniques being employed by research publications of similar nature. Copy prepared on this basis looks forward to the establishment of a standard style for all Association research studies.

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Since three members of the Board of Associate Editors review an article it is requested that at least two copies of the manuscript (the original and a clear carbon) be submitted in order to facilitate reviewing. One copy of the article should be retained by the author for checking against galley proofs.

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EXAMPLE OF FOOTNOTE

[3] H. Harrison Clarke. *The Application of Measurement to Health and Physical Education.* New York: Prentice-Hall, Inc., 1946. p. 240.

EXAMPLE OF REFERENCES APPEARING AT END OF ARTICLE

1. OGDEN, JEAN, AND JESS OGDEN. *Small Communities in Action.* New York City: Harper & Brothers, 1946. (books)
2. DEAVER, G. G. Exercise and heart disease. *Research Quarterly,* **10**:24–34, 1939. (periodicals)

or

1. DEAVER, G. G., "Exercise and Heart Disease," *Research Quarterly* **10**:24–34 (1939). (periodicals)

Use of Numbers

Use figures for all definite weights, measurements, percentages, and degrees of temperature (for example: 2 kgm., 1 inch, 20.5 cc., 300°C.). Spell out all indefinite and approximate periods of time and other numerals which are used in a general sense (for example: one hundred years ago, about two-and-one-half hours, seven times). Spell out numbers through nine; arabic figures for 10 and over.

Abbreviations

The metric system being in universal usage, standard abbreviations should be used whenever the weights and measurements are used with figures, i.e., 10 kgm., 6.25 cc., etc. The forms to be used are: cc., kgm., mgm., mm., l., and m. *Gram* should be spelled out in all cases to avoid possible confusion with grain. All obscure and ambiguous abbreviations should be

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Each table should have a descriptive heading and should be specifically referred to in the text by number, *e.g.*, "Table 10," etc., never as "the above table" or "the following table." Number tables from 1 up for the entire manuscript, using Arabic numerals. For graphic presentations, use Roman numerals. Percent should be one word. Use percent sign (%) in table or when it appears in parenthesis in text.

Never single space any tabular material.

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Illustrative material is of two types: pen and ink drawings, which are reproduced by the line engraving process; and photograph, wash drawings, stipple drawings, in short anything containing shading, which are reproduced by the halftone process.

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Lettering should be plain and large enough to reproduce well when the drawing is reduced to the dimensions of the printed page. ($4\frac{1}{8}$ x 7 inches) Most figures can be advantageously drawn for a linear reduction of one-half or one-fourth. Coordinate lettering should be included within the chart. Do not use gummed letters, for they are easily lost.

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be bent or folded in handling, *and paper clips should not be used.* All imperfections in the original copy are reproduced.

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Continued from March Quarterly

RESEARCH ABSTRACTS

Prepared by the Research Abstracts Committee of the National Council of the Research Section, Carolyn W. Bookwalter, Chairman

Anatomy and Physiology

21. Fischer, Ernst, John W. Moore, Helen V. Skowlund, Kathleen W. Ryland and N. Jane Copenhaver. The potassium permeability and the capacity for potassium storage of normal and atrophied muscle, investigated with the radioactive isotope K^{42}. *Arch. Physic. Med.*, **31**(**7**): 429–441. (1940).

Radioactive potassium (K^{42}) was injected intravenously or intraperitoneally into rabbits with one denervated or tenotomied gastrocnemius-soleus muscle. Acutely denervated muscles have an increased and muscles denervated for four or more days have a decreased initial K^{42} exchange rate. Denervation lowers the amount of potassium needed for a metabolic equilibrium. Daily electric stimulation of denervated muscles increases the K^{42} exchange rate for four hours, after which the rate dropped again. In tenotomied muscles the rate of K^{42} exchange is greater than in normal muscles.—*P. V. Karpovich.*

22. Henry, F. M. and W. E. Berg. Physiological and performance changes in athletic conditioning. *J. of Applied Physiology*, **3**(**2**): 103–111 (1950).

Fourteen basketball players and nine track men were tested before and after a seasonal training. The following tests were employed: Time of running 75, 150 and 300 yards; maximum time for a step-pack test; oxygen debt and carbon dioxide produced after a four minute step test.

Oxygen debt and CO_2 production are better measures of improvement in physical condition than performance tests. Of the performance test the 300 yard run was the best and the pack test the least effective measure. The R. Q. of the recovery metabolism was not significantly affected by conditioning.—*P. V. Karpovich.*

23. Henry, F., and J. Fitzhenry. Oxygen metabolism of moderate exercise, with some observations on the effects of tobacco smoking. *J. of Applied Physiology* **2**(**8**): 464, 1950.

The subjects were 18 young men, all habitual smokers. Exercise was performed on a bicycle ergometer. Metabolism was tested by a closed-circuit method. On certain days subjects smoked one or two cigarettes before exercise; on other days they abstained. No statistically significant effect of smoking was observed on: oxygen intake, oxygen debt, net oxygen cost of exercise and rate of recovery.—*P. V. Karpovich.*

24. Gavan, James Anderson. The consistency of anthropometric measurements. *Am. J. Phys. Anthrop.* **8**: 4 (December, 1950).

In order to determine the consistency, differences in repeated measurements when the subject and technique remain constant, of anthropometric measurements 62 measurements taken by six teams on five subjects were analyzed. The standard deviation, corrected for size of mean, was used as the measure of consistency. The analysis showed that the consistency was highest when position of instrument and subject were the only factors involved. Consistency decreased as the landmarks became more difficult to locate and when their location was independent of the measurement. There was further decrease when there was no objective method of placing the structure to be measured in a standard position. The most inconsistent measurements were those

for which the landmarks were defined in terms of previously taken measurements. A classification of measurements according to the factors determining consistency were given.—*The Wistar Institute.*

25. GULLICKSON, GLENN JR., M. OLSON AND F. J. KOTTKE. The effect of paralysis of one lower-extremity on bone growth. *Arch. Physic. Med.*, **31(6)**: 392–400 (1950).
Eighty-eight patients who contracted poliomyelits between the ages of 6 mos. and 14 yrs. were examined 3 to 7 yrs. later. A low correlation was found between muscle strength of the leg and shortening of the femur, but none with shortening of the tibia. The age at which poliomyelitis occurred appears to have no relation to the amount of shortening of the bones.—*P. V. Karpovich.*

26. HIRSCHBERG, GERALD G. AND ARTHUR S. ABRAMSON. Clinical electromyography. *Arch. Physic. Med.*, **31(9)**: 576–587. (1950).
A simple, well illustrated description of the principle, technique and the use of electromyography.—*P. V. Karpovich.*

27. HUDDLESTON, O. LEONARD, JAMES G. GOLSETH, ALBERTO A. MARINACCI, ELIZAbeth Austin. The use of electromyography in the diagnosis of neuromuscular disorders. *Arch. Physic. Med.*, **31(6)**: 378–387 (1950).
This article describes the proper selection of equipment and technic for electromyography and its use in diagnosis of neuro-muscular disturbances. By means of an integrating meter it is possible to evaluate the relative strength of a muscle in terms of electrical units. The article has 16 illustrations of electromyographic records.—*P. V. Karpovich.*

28. MCBEE, MARA, DOROTHY S. MOSCHETTE, AND CLARA TUCKER. The hemoglobin concentrations, erythrocyte counts, and hematocrits of selected Louisiana elementary school children. *J. Nutrition* **42**: 4 (December, 1950).
A study was made of certain hematological values of 515 Louisiana elementary school children aged eight to 13. Accepted standard methods were used in the laboratory analyses of venous blood samples. The mean hemoglobin value for the entire group was 13.1 ± 1.14 gm per 100 ml, with a range of from 6.4 to 16.0. For the hematocrits the mean was 41.3 ± 4.52%, with a range of from 31.0 to 58.0%. Eighty-six and nine-tenths percent of the hemoglobin values, 91.9% of the erythrocyte counts and 96.3% of the hematocrits were within the accepted normal ranges. In order to show the relationships among the hemoglobin, erythrocyte counts, and hematocrits, the mean corpuscular volume, mean corpuscular hemoglobin, and mean corpuscular hemoglobin concentration were calculated according to the formulae of Wintrobe. These corpuscular values of the Louisiana children were compared with the standards of Wintrobe and also of Sturgis.—*The Wistar Institute.*

29. NELSON, PAUL A., J. F. HERRICK AND FRANK H. KRUSEN. Temperatures produced in bone marrow, bone and adjacent tissues by ultrasonic diathermy. *Arch. Physic. Med.* **31(11)**: 687–695. (1950).
The purpose of this study was to determine whether or not ultrasonic radiation could be useful in medical treatment. Anesthetized and unanesthetized (trained to lie quietly) dogs were used. Ultrasonic radiation was applied to hind legs. It was found that this source of energy causes the best selective heating of bone cortex and bone marrow than any other type of diathermy so far used. Ultrasonic radiation will probably be used on small areas. An important drawback of the use of ultrasonic waves is the difficulty of measuring intensity of radiation.—*P. V. Karpovich.*

30. SARNOFF, L. C. AND S. J. SARNOFF. The thimble electrode. A device for the rapid localization of motor points. *Arch. Physic Med.*, **31(7)**: 448–449. (1950).
A flexible plastic thimble electrode worn on the index finger is described. This device facilitates finding and stimulating of motor points, which is of practical importance for intermittent stimulation of the phrenic nerve in order to cause artificial respiration.—*P. V. Karpovich.*

31. SWEENEY, FRANCIS X., STEVEN HORVATH, H. C. MELLETTE AND B. K. HUTT. Infrared heating of tissues. *Arch. Physic. Med.*, **31**(8): 493–501. (1950).

The purpose of this investigation was to determine the relative merits of the near and far infrared rays. Various sources of infrared heat, lamps and heater, were used on the upper thighs or the buttocks of 10 healthy male subjects. Temperature was recorded from the thigh muscles, outer lateral surface of each thigh, one big toe of each foot, a middle finger, and the room air before, during, and after heat application. The far infrared rays were able to penetrate the subcutaneous tissues directly, and therefore faster than the near infrared. For conventional therapy this difference, however, is of no importance. Muscle temperature showed very slight elevation and sometimes a drop. Most elevation of temperature was observed on the skin and in the subcutaneous tissues.—*P. V. Karpovich.*

Education and Physical Education

32. Research Division. Public-school retirement at the half century. *Research Bulletin.* **28** (4), 1950.

Analysis is made of 72 retirement systems—51 state or territorial systems and 21 local system. For normal retirement service requirement in number of years the range is from 20 to 36. Limitations in flat amount of money range from $720.00 to $2800.00. Percents of the final average salary range from 50% to 80%. The various formulae used for determining permanent disability retirement allowances are given. —*Carolyn Bookwalter.*

33. SCHWARTZ, A. N. A study of the discriminating efficiency of certain tests of primary source personality traits of teachers. *Journal Experimental Education*, **19**: 63 (September 1950)

This investigation attempted to measure the relationships existing between teaching efficiency and personality traits. Thirty four seniors in the Department of Education at the University of Wisconsin were the subjects.

Subjects were evaluated on teaching efficiency by their critic teacher after a semester of student teaching, and by the supervising staff of their school after their second year in the field under actual working conditions. Personality traits were measured by 19 Objective Tests of Primary Source Traits developed by Dr. R. B. Cattell and the author, and a student Data Booklet developed by the University of Wisconsin Teacher Personnel Committee. Significant relationships were not found between the individual objective tests and evaluations of student teaching, although individuals with the more pronounced personality traits tended to rate higher in student teaching.

A multiple correlation of .74 was found between the criterion of teaching success and the combination of measures for reaction time, two hand coordination, and scores on the Washburne Social Adjustment Inventory.

Some of the tests of primary source traits are as indicative of teaching success as total grade point average, professional grade point average or the Washburne Social Adjustment Inventory.—*Marjorie Phillips.*

34. WILLGOOSE, CARL E. The Relationship of muscular strength to motor coordination in the adolescent period. *Journal Educational Research*, **44**: 138 (October 1950)

Three groups of subjects were used in an attempt to show what relationships if any exist between muscular strength and motor coordination among adolescents.

Three hundred secondary-school boys, ranging in age from 15 to 18 were measure on the standing broad jump, 75 junior-high school boys, ranging in age from 13 to 15 were measured on the 30 yard crab race, and 500 junior- and senior-high school boys, ranging in age from 12 to 18 years, were measured on the 50 yard dash. Boys in all three groups were measured on Roger's Strength Index Test.

In every case, where boys were classified according to Strength Index scores, mean performance on the motor coordination tests improved as Strength Index improved.

When age was used as the classifier, improvements in motor coordination tests were not as great.—*Marjorie Phillips.*

Nutrition

35. SALCEDO, JUAN, M. D. BAMBA, EUFRONIO O. CARRASCO, GREGORIO S. CHAN, ISABEL CONCEPCION, FRANCISCO R. JOSE, JOSE F. DELEON, SALVADOR B. OLIVEROS, AND RAMON C. VALENSUELA. Artificial enrichment of white rice as a solution to edemic beriberi. Report of field trials in Bataan, Philippines. *Journal of Nutrition*, **42:** 4 (December, 1950).

Substantially exclusive use of white rice fortified with 2 mg thiamine, 16 mg niacin and 13 mg iron was introduced on October 1, 1948, among 63,000 people comprising the population of the east coast of Bataan, Philippines. The remainder of the province served as a control area receiving the customary white rice. Comparable clinical surveys of this population plus that of two other towns in the control area, were conducted during the latter half of 1947 and the latter half of 1949. About 12,000 people were examined in each survey, about 88% of the total number being individuals who were inspected in both surveys. The incidence of beriberi symptoms among these people declined 89% in the second survey as compared with the first in the experimental area. In the control area (29,000) the incidence of beriberi rose slightly during the same period. Beriberi mortality has progressively declined in the experimental area from 263 per 100,000 in 1947–1948 to 28 per 100,000 in 1949–1950. No deaths from beriberi were reported from April 1 to June 30, 1950. Infantile beriberi mortality declined 53% in the experimental area from 1947–1949.—*The Wistar Institute.*

Book Review

GEORGE ZEPHIRIN DUPAIN. Exercise and Physical Fitness. An Introduction to the Study of the Theory and Practice of Bodily Exercise. Cloth 20s. Pg. 261, with 91 illustrations. Shakespeare Head Press Pty, Ltd., Sydney, Australia, 1948.

This book is written by an Australian pioneer in physical education and appropriately dedicated to the memory of two American pioneers—Drs. Dudley Allen Sargent of Harvard and James Huff McCurdy of Springfield.

It represents the outcome of 45 years of practical experience coupled with a continuous search in scientific literature for guidance and explanation. It is, therefore, only natural that the book is composed of two main sections—the theoretical and the practical.

Section one includes a discussion of the fundamental acute and chronic bodily changes induced by physical activity. It also contains chapters on Exercise and Resistance to Disease; Exercise and Biotype; Exercise and Woman; Climate and Physical Fitness; and Some Superstitions About Exercise. Scientific data in this section are presented clearly and interestingly. What particularly impressed the reviewer is the author's apparent effort in subjugating his personal experience to cold facts obtained through scientific investigation.

Section two considers physical activities according to age, sex, parts of the body to be developed, and amount of physical activity needed for proper development. This section may serve as a guide for learning and performing activities without an instructor.

This book undoubtedly will be a welcome addition to the library of any American Physical Director and of intelligent, non-professional readers wishing to improve their physical fitness. *P. V. Karpovich.*

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